GRAPHICS TABLET™

OPERATION AND REFERENCE MANUAL

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INTRODUCTION

Welcome to the world of the Apple Graphics Tablet. The Tablet is a device which converts the position and movements of a special pen into numbers which your Apple can use and understand. The programs, or "software", supplied with your Tablet tell the Apple how to draw pictures on its high-resolution graphics screen, using the information supplied by the Tablet. These programs turn your Apple and Tablet into an artist's sketchpad, an engineer's drawing board, or a mathematician's chalkboard. With the Tablet and the supplied programs you can draw freehand pictures on the Apple's screen, or use the Apple to draw straight lines, rectangular boxes, open frames, or tiny dots. The pictures you create can easily be saved on Apple diskettes and recalled anytime you want. You can use the Apple to calculate the areas and distances of shapes and lines you draw on the Tablet, and you can change the scale of the figures you draw.

This is the Operation and Reference Manual for the Apple Graphics Tablet. The Graphics Tablet is a "hands-on" product, and the best way to learn how to use it is to take pen in hand and start experimenting. Most of this book is based on the assumption that you have the Graphics Tablet set up in front of you, and are following and doing each example as it is presented. If you try to learn how to use the Tablet without using this manual (or even worse, read the manual without actually using the Tablet), you might pick up most of the simpler commands, but you'll never master the more powerful functions of the Tablet. So read the manual, repeat the examples, and don't be afraid to experiment.

The first chapter of this book describes how to set up your Tablet, and what you need in order to use it. Chapter 2 introduces you to the Graphics Tablet software. This is a set of programs which allow you to use the Tablet to draw pictures on the Apple's high-resolution graphics screen. You do not need to know much about the Apple in order to use the Graphics Tablet. In fact, all you really need to know is how to turn it on. Once you start using the Tablet software, it will guide you each step of the way. You do not need to know how to write programs to use the Tablet skillfully and efficiently.

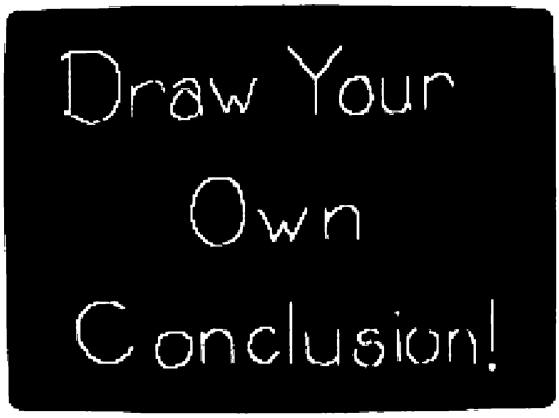
If you do know how to program, you may be interested in Chapter 3. It will give you assistance in modifying the Graphics Tablet software to your liking, including adding your own features to the Tablet menu. There are also instructions on interfacing directly to the Tablet's firmware, so you can write your own special-purpose programs that will use the Tablet. Listings of the programs which operate the Tablet are supplied in Appendix D.

If you see the symbol

it means that the following paragraph contains important information about some Tablet behavior that you might not anticipate. The symbol

means that the following paragraph contains special information you should note. Read these sections carefully.

Above all, feel free to play around with the Tablet. The Apple Graphics Tablet is easy to learn, easy to use, and hard to mess up. With some simple maintenance (described in Appendix A), your Tablet will give you years of enjoyment and use. So sit down at your Apple, take pen in hand, and turn to Chapter 1. We'll let you...



CHAPTER 1
GETTING STARTED

WHAT YOU WILL NEED

To use the Apple Graphics Tablet with its supplied software, you will need the following:

1) An Apple II or Apple II Plus computer, with 48K bytes of Random Access Memory (RAM);

2) If you do not have an Apple II Plus, you will need an Applesoft Firmware card (part number A2B0009), or an Apple Language System (part number A2B0006) with a BASICS language diskette;

3) An Apple Disk II plug-in controller card with at least one Disk II disk drive;

4) A color or black-and-white video monitor.

In addition, you may wish to have additional Disk II disk drives and controller cards.

The Graphics Tablet was designed to work with most present and future Apple II hardware and software. However, the supplied programs which operate the Graphics Tablet are designed to work with the Apple II DOS disk operating system, versions 3.2 and up. The Graphics Tablet software will not operate under previous versions of DOS or in an Apple Pascal environment.

It is helpful (but not necessary) to have read the following manuals:

1) The Applesoft Tutorial (product number A2L0018)
   Welcome and Chapter 1

2) Do's and Dont's of DOS (product number A2L0012)
   Preface through Chapter 2

If you are using the Apple Language System, by sure to read:

Apple Language System (product number A2L0024)
Chapter 3: Using BASIC

UNPACKING

Your Graphics Tablet package contains ten items:

1) The Graphics Tablet and its attached cable.

2) The Graphics Tablet's indicator pen and its attached cable.

3) A printed-circuit board (the Graphics Tablet Interface card)

4) A mylar "menu" overlay.

5) Two "GRAPHICS TABLET SOFTWARE" diskettes.

6) A piece of die-cut, double-sided foam tape.

7) A warranty card.

8) A packing list.

9) This manual.

10) A static cloth.

Save the packing material in case you wish to transport your Tablet -- or in the unlikely event that you must return your Tablet to your dealer for service. If you did not fill out your warranty with your Apple dealer before you brought your Graphics Tablet home, send it in now -- not only does this ensure that any warranty repair your Tablet may need will be done as quickly as possible, but it also puts you on the mailing list for CONTACT, the Apple users' newsletter that keeps you informed of updates and new products.

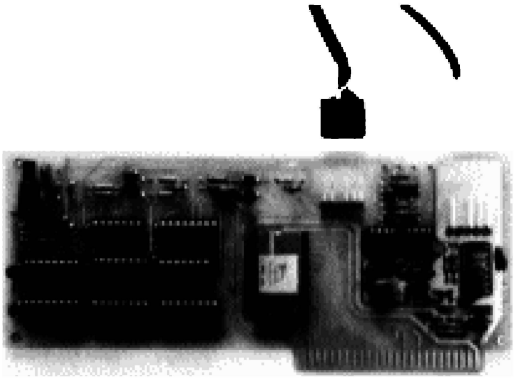
PLUGGING IN

***** Special Note *****
Before connecting or disconnecting
ANYTHING
on the Apple or
the Graphics Tablet
TURN OFF THE POWER.
This is a must.

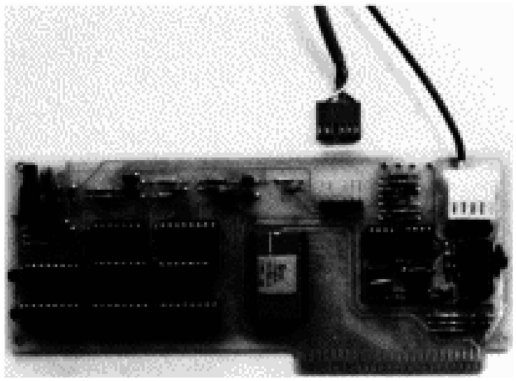
Please pay special attention to this warning. If you try to connect or disconnect something from the inside of your Apple when the power is on, there is a good chance that you may damage the electronics.

The Graphics Tablet and its pen connect to the Interface card, which in turn plugs into one of the eight peripheral connector slots in the inside of the Apple, along the back of the main board. The cables attached to the Tablet and the pen terminate in small sockets, which fit over two sets of pins on the Interface card. The sockets are spaced and keyed so that it is very difficult to attach them incorrectly.

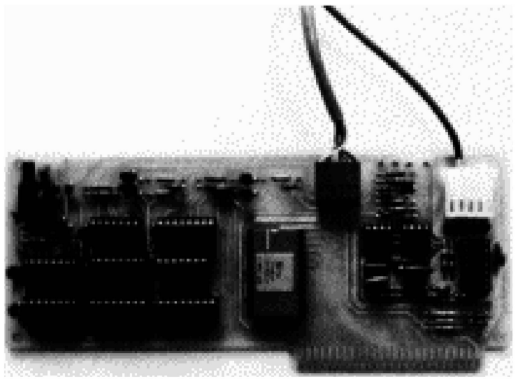
Handle the Interface card as you would handle a high-quality, expensive phonograph record. Grasp it only by the corners or edges, and try not to touch the delicate components or pins. Don't grasp the card by the gold "fingers" -- they are the medium through which the Apple communicates to the Tablet and their efficiency is decreased if they are dirty or scratched. The Interface is a precision instrument and should be treated with care.



First attach the Tablet's pen to the interface card. Place the Interface card on a flat surface with the components face up and the gold "fingers" nearest you. Take the connector at the end of the cable from the Tablet's pen. Notice that the four tiny round holes on the bottom of the connector are keyed to correspond to the set of four pins in the upper right corner of the Interface card. Gently slide this connector over the set of pins. There should be some space between the card and the connector. The finished connection should look like this:



Now attach the Graphics Tablet to the Interface card. Take the connector at the end of the cable from the Graphics Tablet. Gently slide the connector over the set of pins near the top middle of the Interface card. When the connector is properly attached there should be some space between it and the card. The finished connection should look like this:



INSTALLING THE INTERFACE

To install the Graphics Tablet Interface card (which you have already connected to the Tablet and its pen) into the Apple, you will simply plug the Interface card into the back of the computer, as follows:

1. Turn off the power switch at the back left corner of the Apple. This is important to prevent damage to the computer. Don't unplug the Apple, just turn it off. If you unplug your Apple, you isolate it from the common earth ground and your Apple and Tablet Interface card could be in danger from static discharges.

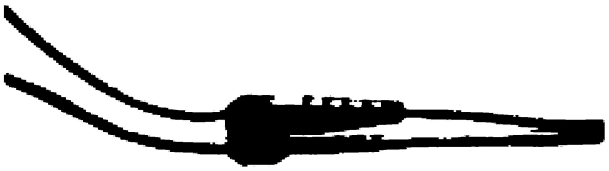
2. Remove the cover from the Apple. Do this by pulling up on the back edge of your Apple's lid until the corner fasteners pop apart, then slide the lid back and lift it off.

3. Before proceeding, touch your hand to the metal power supply case inside your Apple. This will remove any stray static charges from your hands, so you do not damage the static-sensitive components on the Interface card.

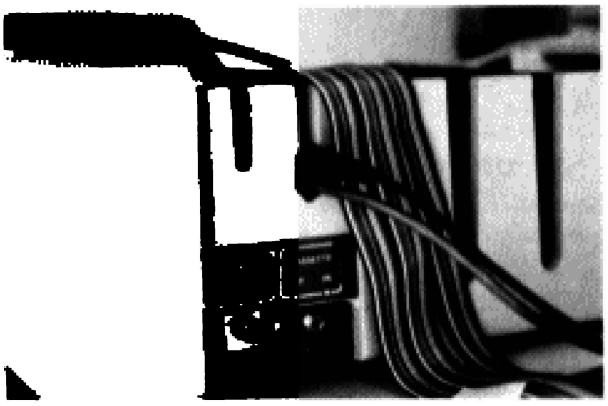
4. Inside the Apple, across the rear of the main green board, are eight long, narrow sockets called Peripheral Connectors, or "slots". The leftmost slot (looking from the keyboard end) is called "Slot #0" and the rightmost is called "Slot #7". The Interface card will operate in any slot except #0, but it is customary for the Tablet to use Slot #5, the third one from the right.

5. Grasp the upper corners of the card between the thumbs and forefingers of both hands. Insert the gold "fingers" of the Interface card into the chosen slot in the back of the Apple, rear edge first. Gently push the front edge of the card down until it is level and firmly seated.

6. Take the two cables which you have connected to the Interface card. On the cable attached to the pen there is a black plastic fitting. This is called a strain relief. There is a hole running lengthwise along the bottom of the strain relief, with a slit running the length of the hole. Pry the slit open with your fingernail and slide the cable from the Tablet through the slit and into the hole. The finished strain relief should look like this:



Now take the strain relief with its "tail" on top and pointing out the back of the Apple and slide it into the leftmost of the two smaller vertical notches in the back of the Apple's case. Slide it down to the bottom of the notch. It should be a tight fit. If it doesn't slide all the way down the first time, pull it out and slide it back in again. The plastic is pliable enough so that it will conform to the slot's width after about three or four insertions.



7. Snap the top back onto your Apple. Place the Tablet on a flat surface near your Apple, close enough so that the pen can easily reach all parts of the Tablet surface. Make sure that your disk drive and video monitor are connected properly.

BACKING UP THE DISKETTE

Now that your Graphics Tablet is all hooked up, it's a good time to think about an important rule of thumb. "What rule?" you might ask. The rule is this: Always keep at least one backup copy of any diskette whose information you wish to keep.

The value of a backup copy cannot be overemphasized. Right now, if you were to drop both your Graphics Tablet Software diskettes, and your pet turtle started nibbling on them, or somebody mistook them for square, black Frizbees, or some other catastrophic event occurred which would render them both unreadable, then your Graphics Tablet would be almost useless. Honest. You'd have to write all new programs yourself, or buy another Graphics Tablet Software diskette, in order to use your Tablet.

Take a look at the two Graphics Tablet Software diskettes that came with your Graphics Tablet. Notice that one of them has a small piece of silver tape over the rectangular notch on its edge. This piece of tape is called a write-protect tab. The write-protect tab tells the Apple not to store any more information on the diskette in question. The tab assures that none of the information on the diskette will be accidentally written over. Store this write-protected diskette in a safe place, and use it as your backup copy.

Fortunately, you know better than to leave your Graphics Tablet diskettes lying around where they might be damaged by heat, your pet turtle, or strong magnetic fields. However, you may want to be really careful and keep two backup copies instead of just one. Keeping more than one backup copy insures that your programs will be safe even if one of your backups is accidentally destroyed. If you don't know how to go about making copies of the Graphics Tablet Software diskette, see Appendix B in this manual for instructions.

Don't put your Graphics Tablet Software diskettes, or any other diskettes, on top of the Tablet itself! Its magnetic field will wipe out any information on the diskettes.

STARTING UP

After you've reassembled your Apple and its peripherals and everything is in order, place your Graphics Tablet Software diskette into Drive 1. Remember to use the one that does not have the silver write-protect tab over the rectangular notch on its edge. Now turn the power on and "boot" the diskette. (If you don't understand what this means, STOP! Don't kick your diskette, but read the section called BOOTING DOS in Chapter 2 of your DOS manual, or Chapter 3 in the

Language System Manual if you have an Apple Language System.) The disk drive will whirr and click for about 15 seconds, then the Graphics Tablet logo will be displayed:

To begin your encounter with the Tablet, press the ESC key. The screen will display the Graphics Tablet "HELLO Menu", which is a list of things you can do with your Graphics Tablet Software diskette. You'll be using the MENU ALIGNMENT program first.

THE MENU OVERLAY

Included in your Graphics Tablet package is a mylar overlay called the "Graphics Tablet Menu". You will be placing this overlay in the center of the recessed area on the Tablet. The overlay divides the surface of the Tablet into different areas, and each area has a different meaning. Part of the overlay represents the Apple's high-resolution graphics screen, and another part lets you select which functions of the Tablet you want to use.

Once you attach this overlay to the Tablet, you need to tell the Apple the exact location of the overlay on the surface of the Tablet, and the Apple will help you make sure that you've put the overlay on correctly.

ALIGNING THE MENU

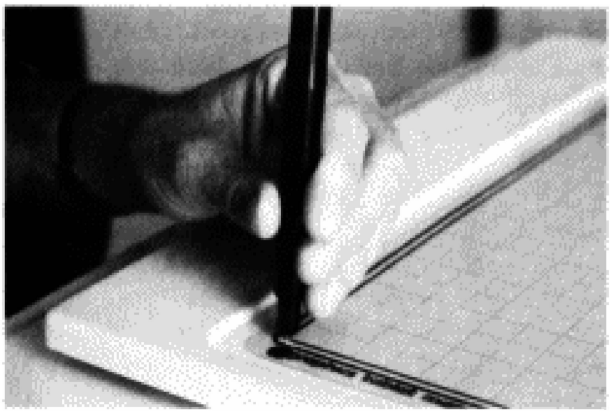
Before you use the Tablet, you must first place the overlay on the Tablet and align it. There is a program on your diskette which will assist you in aligning your menu overlay properly. From the Graphics Tablet HELLO menu, press M to select the MENU ALIGNMENT program, and then press RETURN .

The alignment program tells you what slot your Interface card is plugged into and then creates an information file on your diskette. The name of this file is TAB.INFORMATION . All other programs which use the Tablet can read the vital information about your Tablet and menu from this file. After you run the MENU ALIGNMENT program once, you need not run it again, unless you remove your menu overlay from the Tablet or use your Tablet with a different pen.

The MENU ALIGNMENT program will guide you in attaching and aligning the menu overlay. All you need to do is read its instructions carefully, and do just as it requests. If the menu ever comes loose from the Tablet during the alignment process, press the [ESC] key to re-start the whole procedure.

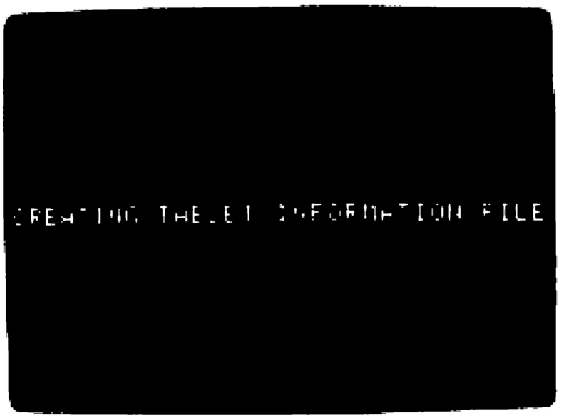
You'll be using four small circles of thin double-sticky foam tape, included with your Tablet, to attach the menu to the Tablet surface. Stick a small circle of tape directly under the target circle in the upper-left corner of the menu overlay, and place the overlay in the center of the recessed area of the Tablet. Stick the overlay to the Tablet surface.

Use the Graphics Tablet's pen to point to the small circle in the upper-left hand corner of the command box labelled RESET. Hold the pen perpendicular to the surface, and carefully press straight down until the point retracts into the pen, making sure that the point of the pen does not slip out of the circle.



Now take the pen and point to the small circle at the lower-left corner of the overlay. Hold the pen straight and press down. The Apple will now determine whether the overlay is straight or crooked. If it is straight, the screen will display "ALIGNED" and you can proceed. If the overlay is crooked, the program will ask you to swing the bottom edge of the overlay a little to one side. Move the overlay just a little in the proper direction and try again. Continue until the screen displays "ALIGNED". Place circles of tape under the remaining three target circles and stick them firmly to the Tablet surface. You may want to press ESC to end the program and then re-RUN it to make sure you didn't accidentally move the overlay when you were taping down the corners.

Now follow the arrows displayed on the screen and press the pen down in each small circle in all four corners of the overlay. Be very careful! Make sure that you're holding the pen straight up-and-down, and that the point of the pen does not stray outside of the target. If you do it correctly, you will be rewarded with the message



If you get any other message, you probably slipped somewhere, or the overlay isn't centered on the Tablet surface. Try it again.

Once the overlay is aligned, the Apple will return you to the Graphics Tablet logo. Press ESC to get to the program menu again. Now you can start using your Graphics Tablet.

(If you want to be <u>really</u> sure that your menu is properly aligned, you can run the MENU ALIGNMENT program again. Leave the menu taped down and just poke the proper points with the pen. If everything goes well, then your menu is well-aligned. If not, repeat the MENU ALIGNMENT procedure.)

CHAPTER 2
THE GRAPHICS TABLET SOFTWARE

GET READY

To start using the Graphics Tablet, go to the Graphics Tablet logo, eitner by re-booting the diskette, completing the MENU ALIGNMENT program, or typing

RUN HELLO

Press ESC . Now press G to select GRAPHICS TABLET SOFTWARE and press RETURN . The disk will whirr and chug for a while, and the Apple will present you with a blank screen. (If you get a message informing you that the Tablet information file does not exist, press [RETURN] and run the MENU ALIGNMENT program.) In about three seconds, your Tablet will be ready to use.

DRAWING

Touch the point of the Tablet's pen lightly to the surface of the Tablet. Move the pen around. You should see a small "crosshairs" cursor moving around the screen as you slide the pen around. The crosshairs are a locator, and the position and motions of the crosshairs on the screen correspond to the position and motions of the pen on the Tablet. Now press down on the pen so that the point retracts, and start drawing. As you draw on the Tablet, the path you trace will show up on the screen as a thin white line.

The top and sides of the working area of the overlay (the area with the fine mesh gridwork) correspond to the top and two sides of the Apple's screen. However, the working area on the overlay is slightly taller than the screen. To compensate for this difference in height, only the upper 2/3 of the overlay's working area is "mapped onto" the screen. The rest, about 2.5 inches (6.35 cm) at the bottom of the working area, is not usually active. (For information on how to use

(the full working area, see the WINDOW command.) You might want to find the lower boundary of the working area and mark it with a felt tipped pen on the overlay.

THE MENU

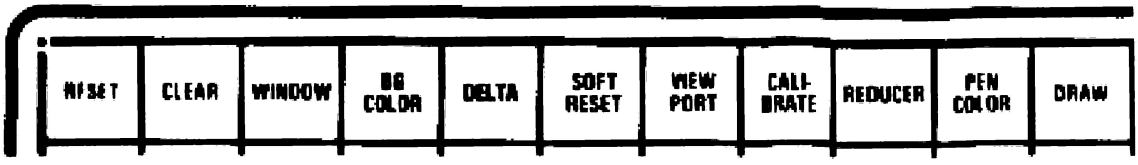
Along the top of the Tablet's Mylar overlay are two rows of 22 squares. Each square in the top row carries the name of a certain command or function which the Tablet software can perform. These two rows of squares are called the Tablet Menu. They let you order functions for the Tablet as you would order food in a restaurant in a foreign country: by pointing to what you want. If you could speak the proper language, you would order dinner by telling the waiter what you would like. But the Tablet's language consists of thousands of magnetic and electrical impulses traveling near the speed of light. Most people can't communicate in this fashion (those who can are mutants, and thus have gone far in the computer world), so you'll have to indicate your choices to the Tablet by pointing at the Menu.

To invoke a command or function, touch the point of the Tablet's pen anywhere inside the corresponding square and press down. Hold the pen down until you hear the Apple beep. If you don't hear a beep, then you haven't fully activated the command, and you should lift the pen and try again.

The second row of boxes, which carry no name, consequently have no function. You can use them for your own programs (see EXTENDING THE MENU in Chapter 3).

The following pages describe each command and its function. To help you locate the square for each command, the section describing that command will be headed with a drawing of the menu and a pen pointing to the proper square.

DELTA

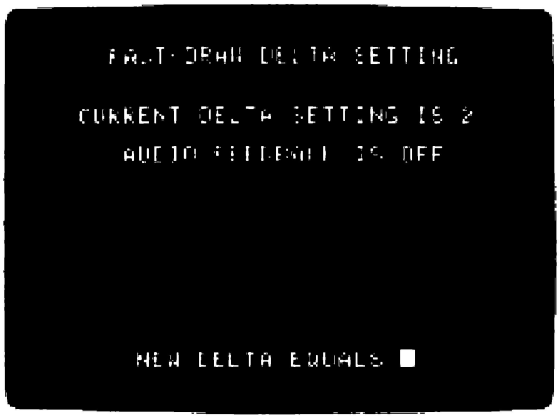


The DELTA function lets you adjust the precision with which the pen draws on the screen. The Apple subdivides the working area of the Tablet into 53,760 small dots, each one corresponding to one dot on the Apple's screen. As you move the pen around the surface of the Tablet, the Apple draws lines between the dots you traverse. The DELTA setting lets you control the distance the pen can move before the Apple draws a line to the new dot. The smallest possible DELTA is 1. This setting will make the Apple draw a new line each time you move the pen a vertical or horizontal distance of one dot from the

Tablet, about .039 inches or 0.997 mm) from the last dot plotted. The normal value for DELTA is 2. The largest DELTA value is 127. This will make the Tablet draw a new line only after the pen has moved a horizontal or vertical distance of 127 dots (4.98 inches, or 12.6 cm) from the last dot plotted.

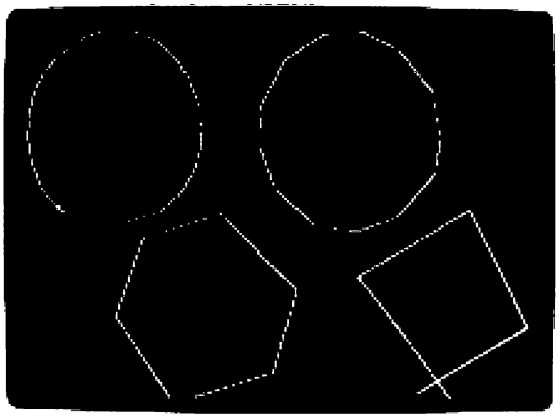
Associated with the DELTA setting is the Audio Feedback feature. When this feature is turned on, the Apple's speaker will emit a click each time the Apple draws a new line. With the Audio Feedback feature enabled, you can actually hear as well as see the effects of different DELTA settings.

To look at or change the current DELTA setting, touch the pen to the DELTA command square. Press it down until you hear the Apple beep. You'll see the following:



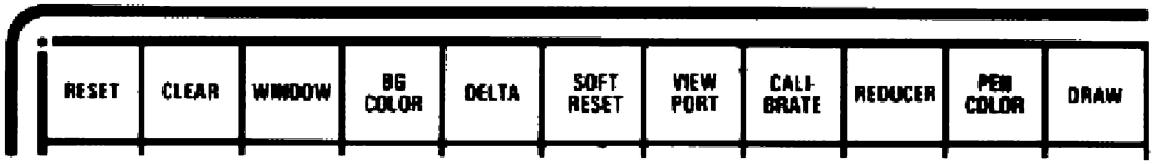
The first few lines tell you the current DELTA setting and whether the Audio Feedback feature is ON or OFF. The Apple will ask you for the new DELTA value. If you wish to retain the current DELTA value, just press RETURN . If not, type a number between 1 and 127 and press RETURN . Next, you'll be asked whether you want the Audio Feedback ON or OFF. Again, if you wish to retain the current setting, just press RETURN . Otherwise, type the word ON (to produce the clicks) or OFF (to silence the clicks) and press RETURN . The Apple will then return you to the picture you were drawing, with the new DELTA and Audio Feedback settings in effect.

Experiment a little with different DELTA settings. Set a cup or saucer on the Tablet surface and trace its perimeter several times, using different values for DELTA each time. You'll get something which looks like this:



Turn the Audio Feedback ON and OFF, and use it at different DELTA settings. At low settings, it will buzz as you move the pen around; at higher settings, you'll be able to detect distinct clicks.

THE COLOR MENU



The Apple's screen can display six colors: black, white, green, violet, orange, and blue (of course, if you are using a black-and-white monitor, you'll see only various shades of grey). The Apple lets you draw on the screen with all of these colors.

Touch the pen to the command box marked PEN COLOR and press down. The Apple will beep, the screen will clear and the message

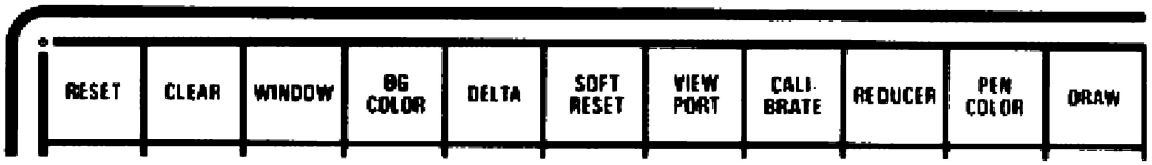
CONSTRUCTING COLOR MENU

will appear at the bottom of the screen. The Apple will proceed to draw eight colored boxes, surrounded by a grey border.

Move the pen lightly across the surface of the Tablet. You'll see a small block drifting around the screen (instead of the usual crosshairs). Use the pen to position the block over the color with which you wish to draw, and press down. The color menu will vanish, and you will be looking at the screen on which you were previously drawing. Now, draw! The lines you draw will be in the color you selected. Change colors again and keep drawing. All the rules are the same. Only the colors have been changed.

If, while you're shopping around for a new PEN COLOR, you decide you really don't want to change the color you've got, just press [redacted]. Your PEN COLOR will not be changed.

SOME BACKGROUND INFORMATION



When you start drawing with the Graphics Tablet, you're given a black screen on which to create. You can tell the Tablet that you wish to use a different-colored background by pressing the pen in the BG COLOR (BackGround COLOR) square. The Apple will present you with a color menu (as for the PEN COLOR command). Pick the color you want to use as a background; for instance, orange. The menu will vanish and the screen will instantly be filled with orange, or whatever color you have chosen.

Using the BG COLOR command will erase everything you had on the screen, so if you want to specify a BackGround COLOR, do it before you start to draw.

Are you trying the examples? Is the BackGround COLOR command working? Is orange your favorite color? Again, if you decide not to change the BackGround COLOR, just press RETURN instead of selecting a color. Your BackGround COLOR (and your picture, too) will be left unchanged.

A BRIEF DIGRESSION ON HIGH-RESOLUTION GRAPHICS

By now you must have noticed that there are some funny things going on with the colors. For example, set the BackGround COLOR to green and try to DRAW blue lines across it. Or set the BackGround COLOR to violet, and draw some blue lines. Obviously there's something wrong. The color "shadows" and the "zebra stripes" which you see on a color television set, or the strange distortions, unevenness, and lack of consistency you observe on a black-and-white monitor, are the results of the Apple's method of generating colors in its high-resolution graphics display. For more information on the anomalies of the Apple's high-resolution graphics color generation scheme, see Appendix C.

GUIDELINES

To minimize the problems created by the Apple's high-resolution graphics color scheme, follow these guidelines:

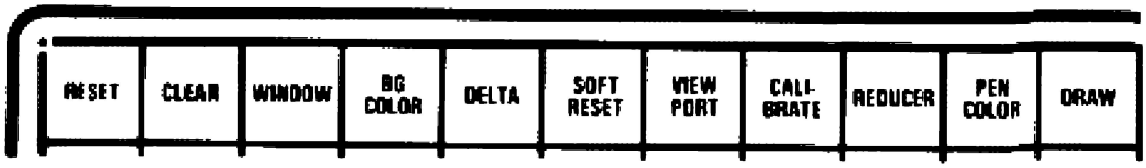
1) Most inconsistencies of the Graphics Tablet colors occur with vertical lines. Use horizontal lines when possible.

2) When you're drawing with black or white on a colored background, or in color on a black or white background, draw the lines a little thicker than normal by going over them twice. This takes care of the broken lines you may get.

3) If you need to place two colored blocks next to each other, stack them vertically, not horizontally. This cures the colored shadows that sometimes appear between colors.

So much for the digression, on with the Tablet.

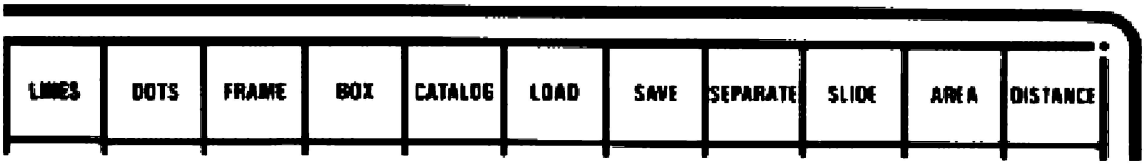
A CLEAR ALTERNATIVE



If you're tired of the scribbles and doodles on your screen, press the pen to the CLEAR square. Zap! Your whole screen will be restored to the BackGround COLOR (see the previous section). Draw mode will be restored, and, if you haven't set one, the BackGround COLOR will be black.

If you have set a VIEWPORT (described a little further on in this chapter), then CLEAR will affect only the portion of the screen inside the VIEWPORT. The rest of the screen will remain unchanged.

LINE UP



So far, you've been happily drawing somewhat rough, freehand lines on the Apple's screen. If you wanted to draw a straight line between two points, you probably tried to draw it with a straightedge (smart, but awkward) or did it freehand (sloppy). "Is there a better way to draw straight lines?!", I hear you cry. Well, guess what! Yes, there's a better way to draw straight lines. Press the pen to the box which, for some obscure reason, bears the designation LINES. Now you have entered LINES mode. You will remain in LINES mode until you tell the Apple otherwise. We'll tell you how to do that later.

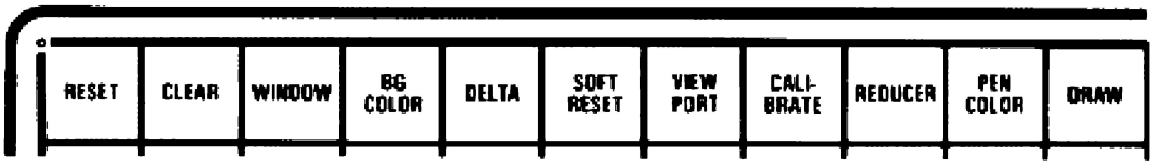
Meanwhile, since you're in LINES mode, let's draw some lines. Press the pen down anywhere on the Tablet's working area and lift the pen again. See the small dot left on the screen? That will be one endpoint of your line. Now press the pen down at another point in the working area. Zap! There's now a straight line connecting the two points. Press the pen down again at another point, and the Apple will draw another line, this one connecting the new point and the second point. Now rush to your nearest toy store and buy a Connect-the-Dots coloring book. Pick out an interesting page, tape it to your Tablet, and start connecting dots. The figure will magically appear on your screen.

If you want to start a second LINES figure, simply press the pen to the LINES command box again. The next point at which you press the pen will be the beginning of a new figure.

The "straight" lines you draw with your Tablet may not seem absolutely straight to you. This is normal. Lines that are neither horizontal nor vertical are actually made up of tiny zig-zags between dots on the screen.

Once you enter LINES mode, you'll stay in LINES mode until you ask to leave. The proper way to ask to be excused is to press the pen to a box that represents another drawing mode.

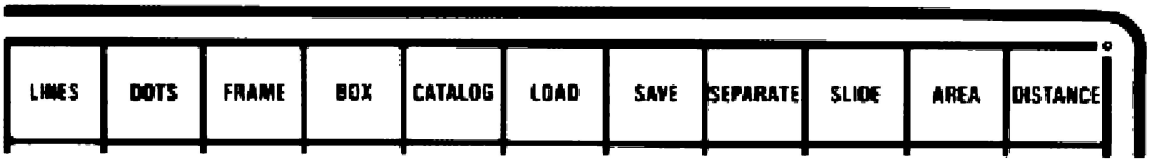
DRAW



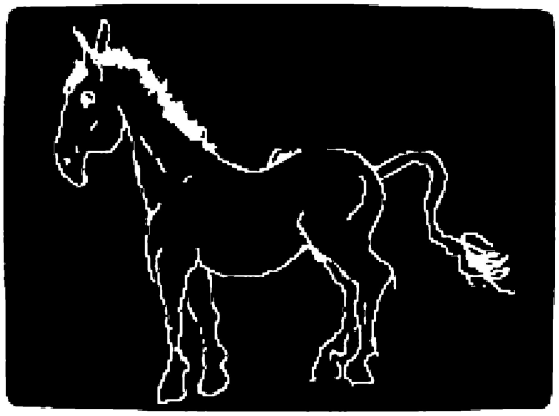
The mode you were in before you entered LINES mode is called DRAW mode. DRAW mode is the normal state of the Graphics Tablet and is automatically put into effect when you choose the Graphics Tablet Software from the diskette menu. This means that DRAW mode is the default mode.

Whenever you wish to leave a fancy drawing mode (LINES, BOX, FRAME or DOTS), simply press the pen to the command square called DRAW. Your picture will be left intact and you will be able to draw normally until you specify another mode.

YES, SIR, DOT'S MY BABY



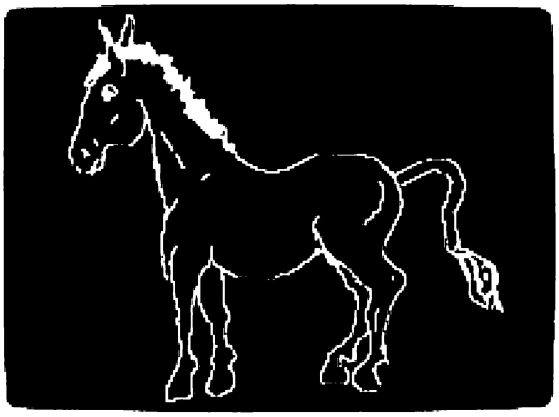
Once you've got a picture on the screen, you might want to edit or change small portions of it. For example, you've drawn this picture:



and you want to fix up the little "glitches" around the edge. There are a couple of ways to do this: you could set the PEN COLOR to black and DRAW the glitches out, you could erase whole portions of the screen and redraw them, or you could simply erase the whole thing and start over. Fortunately, there's an easier way. Press the pen to the square marked DOTS. You are now in DOTS mode, and will remain in DOTS mode until you specify another. While you are drawing with DOTS, the

Graphics Tablet will let you plot individual points on the screen. Each time you press the pen down in the working area you will plot one, and only one, point on the screen. When you lift the pen up again and press it down in a new place, you will plot another single dot. The dots will be of the color you specified in the most recent PEN COLOR command, or white if you have not selected any other color.

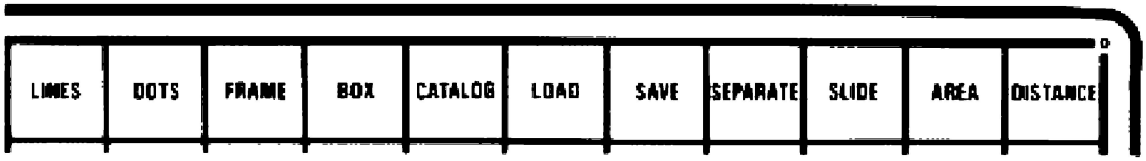
By setting the PEN COLOR to the BackGround COLOR (normally black), setting DOTS mode, centering the crosshairs on the extraneous glitches in the picture, and exorcising them one by one, you can turn a rough picture like the previous one into this:



DOTS mode is also handy for adding shading and texture to your pictures. DOTS mode is most useful when used with VIEWPORT and REDUCER, described later in this chapter.

To leave DOTS mode, press the pen in the command square for any other mode (like DRAW, LINES, BOX or FRAME).

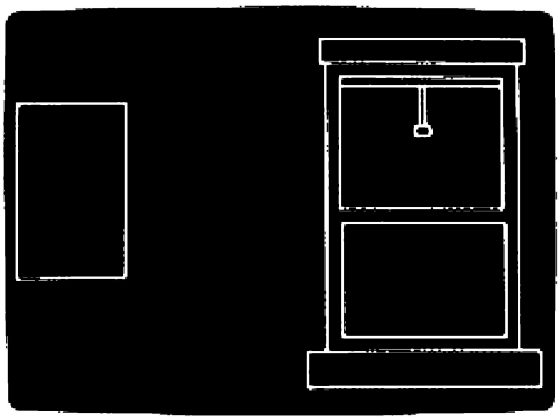
THE BIG FRAME-UP



When you're in the FRAME mode you can draw open rectangular boxes on the screen by specifying two diagonally opposite corner points. To enter FRAME mode, press the pen down in the (suprise!) FRAME command box. Now press the pen down anywhere on the Tablet's working area and lift it again. A single dot will appear on your screen. Take the pen and press it down at another point on the working area. The Apple will draw an open rectangle with opposite corners at the points you specified. Pick another point and press the pen down. Notice that the FRAME mode doesn't draw a frame with the new point and previous

point (as LINE mode would draw a line between them), but instead uses the new point as a corner of a separate FRAME. Pick and press a fourth point to complete the second FRAME.

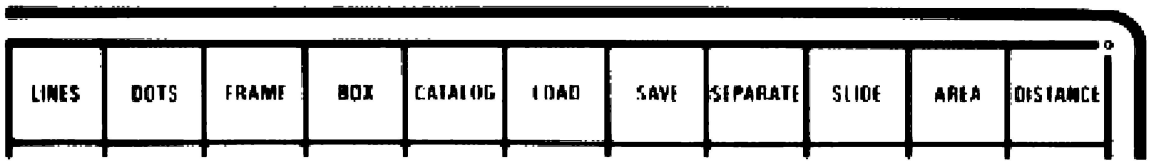
Your FRAMEs can be simple, or you can use many FRAMEs to make a larger, more complicated FRAME:



You can draw your FRAMEs in different colors, too. The FRAMEs will be drawn in the current PEN COLOR, or white if you haven't selected any other color. Beware! Colored FRAMEs may come out with a side or two missing because of the nature of the Apple's high-resolution graphics screen (see Appendix C). If this happens, re-draw the FRAME, but move the corner points very slightly to one side.

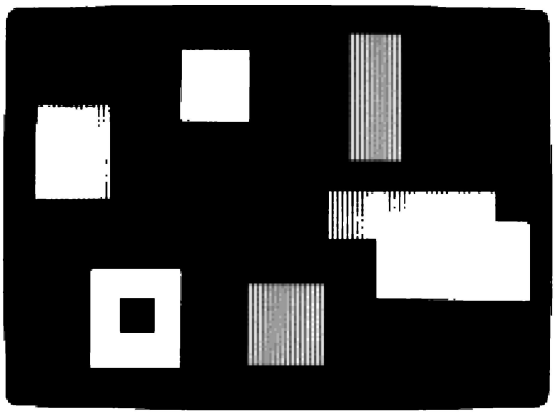
To leave FRAME mode, press the pen in the square for any other mode (such as DRAW, LINES, DOTS, or BOX).

LITTLE BOXES



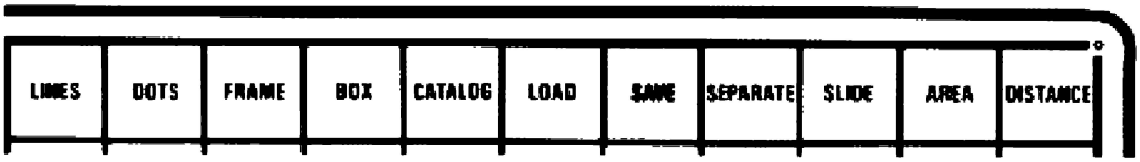
There's a white one, and a blue one,
And a green one, and an orange one,
And they're all made
On the Graphics Tablet
And they all look
Just the same.

Now FRAMEs are nice, but they're kind of rigid. You might even go so far as to say they're empty. If you're looking for something a little more, well, fulfilling than an ordinary rectangular quadrilateral, then the BOX mode is for you. Press the pen down in the square marked BOX. Now press the pen down at two points on the working area, as you did for FRAME. The Tablet software will give you solid indication that the task is completed by drawing a uniform, monolithic box with corners at the two points you specified.



You will remain BOXed into this mode until you free yourself by pressing the pen down in one of the squares marked DRAW, LINES, DOTS, or FRAME. The BOXes you draw will be of the current PEN COLOR. If you have not specified a different color, your boxes will be white.

SAVING PICTURES FOR POSTERITY



By now you should have generated some beautiful (well, at least interesting) artwork. It's a shame that you have to erase it, isn't it? Well, you can save the entire picture for later recovery and further work by pressing the pen in the square marked SAVE. Your picture will vanish (temporarily) and the screen will display the message

```
TYPE A NAME FOR THIS PICTURE.
   ==>
```

A picture name can be from 1 to 26 characters long, and may include letters, numbers, and special characters (except the comma). Unlike normal diskette file names, picture names do not need to begin with a letter; you can have picture names such as

```
1 FOR THE ROAD
```

or

```
     <<SPACE>>                    (notice the spaces before the name)
```

The reason for this is that before the Apple saves the screen onto the diskette, it adds the prefix "PIC." to your picture name to identify it as a bona fide Graphics Tablet Picture. Since diskette file names will always begin with the letter P (in PIC.), your picture names can begin with whatever you please.

The PIC. flag also implies that the picture file includes the Tablet WINDOW setting (see the WINDOW command). Files which do not contain this information should not carry the PIC. flag.

After you type the name of the picture, press [RETURN]. If you decide you don't really want to save the picture yet, just press [RETURN] without typing any name. Your picture will reappear, and you'll be left in DRAW mode.

If you do choose to save your picture, the Apple will then ask you:

```
DRIVE?  ==>     (DEFAULT=1)
```

The Apple will save your picture onto the diskette in the disk drive you indicate. The DEFAULT drive is the drive which the Apple thinks you'll want to use, drive 1 the first time and the drive specified previously each time thereafter. Type the drive number you wish to use and press [RETURN], or just press [RETURN] to select the DEFAULT drive. (If you try to specify any drive number other than 1 or 2, the Apple will use the default drive). The drive will whirr and chug for a moment, then your freshly saved picture will reappear, in DRAW mode with PEN COLOR as it was when you left.

If there is already a picture on the selected diskette with the name you specified, the Apple will display the message

```
A PICTURE ALREADY EXISTS WITH THAT NAME.

          CONTINUE (Y OR N)
```

If you wish to overwrite the current picture which has the name you specified, press Y [RETURN]. If you don't want to destroy the picture on the diskette, press N [RETURN] and repeat the SAVE operation using a different picture name (a lone [RETURN] is accepted as an N [RETURN] response).

If you complete the SAVE procedure, or if your attempt to SAVE a picture is foiled, and you get an error message from the Apple, you will lose any VIEWPORT you may have set (see the VIEWPORT command). If, however, you have aborted the SAVE command with an N [RETURN], the VIEWPORT will remain intact.

If you receive this message:

then any number of things could be wrong: the diskette is full and can hold no more pictures, the diskette is write-protected, or there's another picture on the diskette with the same name and the file which holds that picture is locked. In the first case, simply use another uninitialized diskette. In the second case, remove the diskette, peel off the write protect tab and reinsert the diskette. In the third case, try another file name. Whatever the problem is, you may press the spacebar to attempt to SAVE the picture again under the same name, or press RETURN to cancel the attempted SAVE. Your picture will reappear, and you will be back in DRAW mode.

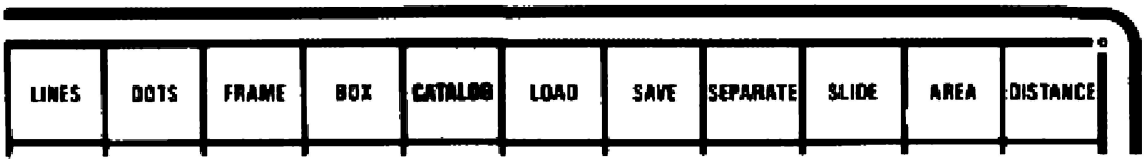
If you filled up the diskette by trying to SAVE a picture, only part of the picture will actually be stored on the diskette. It is best to delete the partial file from the diskette after you have SAVEd the picture on another diskette (see GETTING OUT).

If you receive this message:

while attempting to SAVE a picture, then there are problems. Maybe you specified Drive 2 when you only have one drive, or the diskette is

uninitialized, or the data on it has been destroyed. You could have a faulty disk drive or controller card, or your drive is under the influence of a powerful magnetic field (did you put it on top of your television? Naughty, naughty). There may be no diskette in the drive, or you left the drive door open, or the diskette is crimped and is not rotating. Whatever the cause, press the spacebar to attempt the SAVE again, or press RETURN to get back to your picture. Investigate.

BROWSING THROUGH THE CATALOG



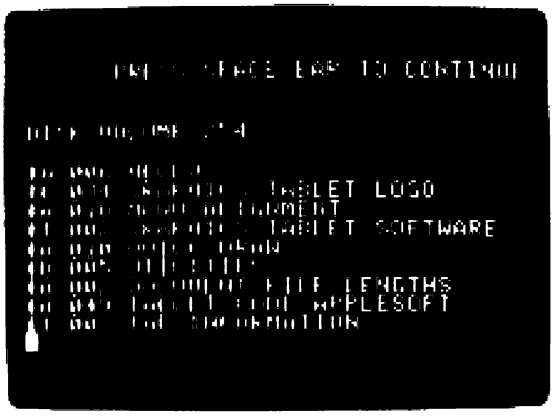
You can look at the contents of your diskette by pressing the pen in the square marked CATALOG. The Apple will ask you (as above) for the drive number. You can select the DEFAULT drive by pressing RETURN .

The message

PRESS SPACE BAR TO CONTINUE

will be centered at the top of the screen. The drive will whirr a bit, and the names of all files on the diskette will be presented. Don't press the spacebar yet! The file names which begin in PIC. are your Graphics Tablet pictures, and should all have the annotation B 033 to the left of them. Incidentally, the B denotes that they're BINARY files, and the 033 means that they use 33 diskette sectors, or a little over 8K bytes of memory, each. If you see any PIC. files which aren't marked B 033, then they're not complete pictures. Change their names (see GETTING OUT) so you don't mistake them for Graphics Tablet pictures in the future.

If you order a CATALOG of the Graphics Tablet Software diskette, these files will be included:



These are all component programs of the Graphics Tablet package. The only notable file is the GRAPHICS TABLET LOGO, which you'll notice has the notation B 034 to the left of it. (The 034 means that it's

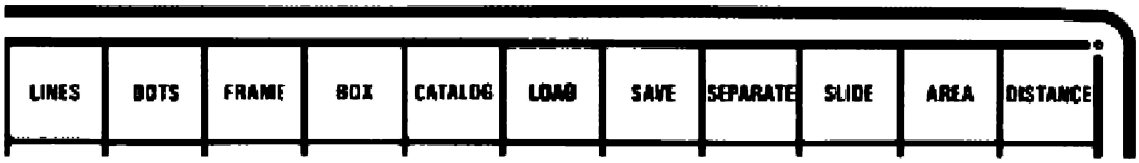
slightly larger than normal Tablet pictures, which are labeled B033. This causes no problems, however.) This is the picture of the Graphics Tablet Logo frame, which you see when you boot the diskette. You can LOAD this picture and work on it, even though it's not a PIC. file (see LOAD, below, for details).

CATALOG can fall victim to the same I/O ERROR problems as noted in SAVE. See the previous section for details.

If the CATALOG listing is too long for the screen, the listing will pause after displaying 18 files. Press the spacebar to get the rest of the CATALOG.

When you've finished looking at the CATALOG, just press the spacebar. Your picture will instantly reappear on the screen, with PEN COLOR unchanged.

GETTING LOADED



Once you have SAVEd a picture on diskette, you can call it back to your screen to be worked on some more, or just bring it out so you can admire it for a minute. Press the pen to the square marked LOAD. The following words will appear:

```
PLEASE TYPE THE PICTURE NAME.
  ==>
```

If you change your mind and don't want to LOAD a new picture, press RETURN . Your previous picture will reappear, and you will be left in DRAW mode with the same PEN COLOR as when you left.

If you do want to LOAD another picture, type the name of the picture which you wish to see, and press RETURN . You don't have to type the PIC., the Apple will supply that for you. The rules for naming pictures are the same as described in the SAVE command.

You will then be asked to specify which drive the diskette with the chosen picture is in. Press RETURN to indicate that it's in the DEFAULT drive, or type the drive number (1 or 2) and press RETURN .

The disk drive will spin for a few moments, then the selected picture will appear on the screen. You will be left in DRAW mode.

LOAD is vulnerable to the same disk I/O ERROR problems as were described in the SAVE section.

You can LOAD picture files which were not created by the SAVE command, as long as they carry the notation B 034 in their CATALOG listing. One such file is the GRAPHICS TABLET LOGO file on your Graphics Tablet Software diskette. Even though this file doesn't have the PIC. flag in front of its name, it can be LOADed and worked upon like any other picture. If you LOAD this file, and SAVE it again, the new version will have the prefix PIC. attached to the name, and will have the notation B033 to its left in the CATALOG.

When the Apple sees the PIC. prefix, it infers that the file contains information about the Tablet WINDOW setting along with the picture. The absence of the PIC. flag indicates to the Apple that it should use the default WINDOW setting (see the WINDOW command). In addition, if you have a picture on the diskette whose file name does have the PIC. prefix, you can make the Apple ignore the Tablet WINDOW setting in that file by typing the PIC. prefix at the beginning of the file name when you LOAD it.

If you LOAD a picture which was SAVEd on another Apple or Graphics Tablet, it's possible that the Tablet which created that picture uses a slightly different WINDOW setting than yours. The difference usually appears as a discrepancy between the motions of the pen across the working area and of the crosshairs on the screen. If the crosshairs don't correspond to the pen position, then re-LOAD the picture, but type the PIC. prefix at the beginning of the file name. This will make the Apple use the proper WINDOW setting for your Tablet.

With one exception, an attempt to LOAD a picture, whether successful or not, will remove any VIEWPORT you may have set (see the VIEWPORT command). If you have aborted the attempted LOAD with a N RETURN or a RETURN, this rule does not apply.

GETTING OUT

With the Graphics Tablet, you can perform three simple operations with disk files: SAVE, CATALOG, and LOAD. In order to RENAME or DELETE picture files, you'll have to leave the Graphics Tablet Software and get back to the Applesoft/DOS command level. To do this, get to DRAW mode and press ESC. The Apple will ask you if you indeed wish to leave.

If you answer Y, you will lose whatever picture you had on the screen! Any other reply will send you back to your artwork, in DRAW mode.

If you answer [Y], then the Apple will run the HELLO program on the diskette, and you will see the Graphics Tablet Logo frame (see Chapter 1, STARTING UP).

Press [ESC] again to get to the HELLO menu. Choose [Q] to QUIT and press [RETURN]. The screen will be cleared and the Applesoft prompt character (]) will appear in the upper-left corner.

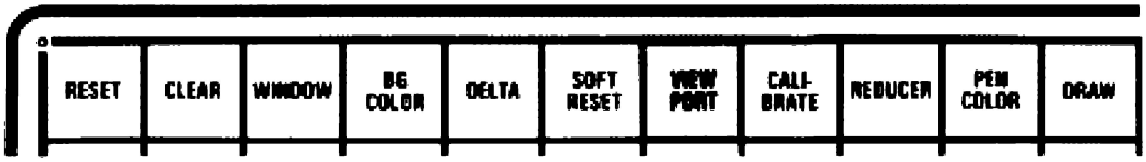
Now you can DELETE, RENAME, LOCK, UNLOCK, or VERIFY any of your picture files on the diskette, or do almost anything else in Applesoft or with DOS. (For details on how to perform these operations, see Chapters 2 and 4 of your DOS manual.) Remember to include the PIC. at the beginning of the pictures' file names! To return to the Graphics Tablet software, type

RUN HELLO

When the Graphics Tablet logo appears, press [ESC], select [G] for Graphics Tablet Software, and press [RETURN]. You'll be working with the Tablet again, with a blank screen, a white pen, no VIEWPORT, the WINDOW at its default setting, the REDUCER off, and in DRAW mode.

DON'T try to RUN the file GRAPHICS TABLET SOFTWARE directly! It is not a program in itself, but is an EXEC file which runs several programs and sets up some parameters necessary for the well-being of the Tablet software. You should always enter the Graphics Tablet Software by selecting it from the HELLO menu.

ROOM WITH A VIEWPORT



Am I to spend the rest of my short life
Confined by these four corners, bright and sharp?
Shall I be limited in my designs
To draw only within this VIEWPORT small?

This cannot be! And yet, there's recompense:
The box which limits, also can protect,
And keep me from destroying what I've wrought.
Confine, protect; the VIEWPORT functions thus.

You can use the VIEWPORT command to select a rectangular area on the screen. Once you set an area for a VIEWPORT, you will be allowed to draw only within that area. This allows you to concentrate on one

area of the screen at a time, while protecting the rest of the picture from being accidentally erased or overdrawn.

The VIEWPORT appears on the screen as four small "L"-shaped corner marks, one at each corner of the VIEWPORT. Each leg of each "L" is three dots long and one dot high. The VIEWPORT itself is the area enclosed by these four corners (the corners are actually outside the VIEWPORT proper). If you change or remove a VIEWPORT, the corner marks vanish without a trace, leaving the screen under them unchanged.

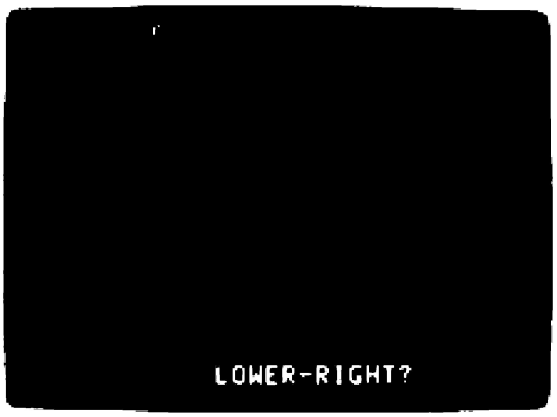
To specify a VIEWPORT, press the pen to the VIEWPORT square on the Tablet menu. The prompting message

UPPER LEFT?

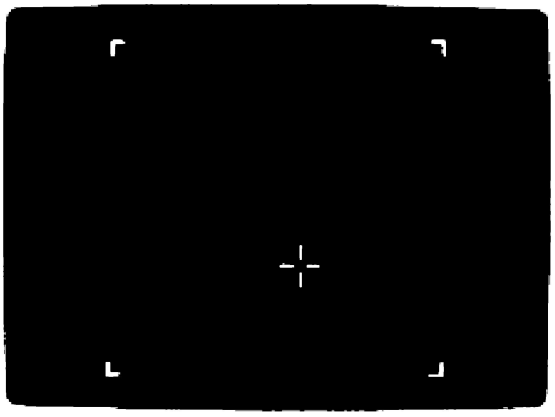
will appear briefly at the bottom of the screen. Position the pen at the spot where the upper-left corner of the VIEWPORT should be (imagine you're drawing a FRAME) and press down. One corner mark will appear, and another prompting message:

LOWER RIGHT?

will be displayed:



Position the pen at the opposite (lower-right) corner of your proposed VIEWPORT, and press down. The other three corners of the viewport will appear. This is how the finished VIEWPORT will look:



Unlike FRAME and BOX modes, in which you can specify the corner points in any order, VIEWPORT really does want the second corner point to be below and to the right of the first. If you give the points in reverse order, or specify an impossible VIEWPORT (one which has no height or width), then you will recieve the message

You will then be asked for both corner points again.

Once you've set a VIEWPORT, what do you do with it? Simple, just DRAW. After you specify the two corner points, and you see the four-cornered frame, you will be placed in DRAW mode with the PEN COLOR unchanged. Anything you DRAW outside of the VIEWPORT simply will not show up on the screen; anything you draw inside it, will. Notice that the crosshairs will appear even outside the VIEWPORT, but pressing down on the pen has no effect.

You can change to any other drawing mode (BOX, DOTS, LINES, or FRAME) and it will work normally inside the VIEWPORT. But if, while you're in one of these modes, you try to specify a point <u>outside</u> the VIEWPORT, you'll receive the admonition

POINT OUTSIDE VIEWPORT. RESPECIFY.

Just choose another point inside the VIEWPORT. If you want to restart the BOX, FRAME, or LINE you're drawing, press the pen to the square for the proper mode again.

If you invoke the VIEWPORT command when another VIEWPORT is already active, the Apple will remove the previous VIEWPORT before asking you to specify a new one.

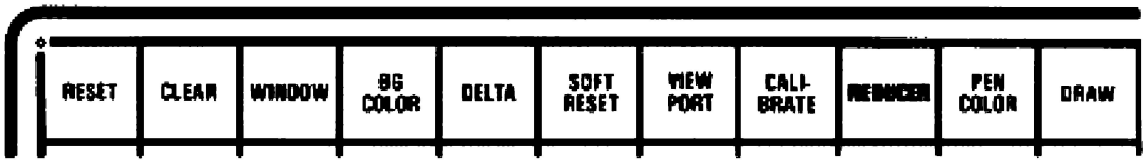
At any time after you have invoked the VIEWPORT command, but before you have finished specifying a new VIEWPORT, you can tell the Apple to give you one of two special VIEWPORTs. One of these is the VIEWPORT you were using before you started to set a new one, and the other is the "default" VIEWPORT (the currently set WINDOW).

To recover the VIEWPORT you had before you started to set a new one, press RETURN before you finish the VIEWPORT command.

To request the default VIEWPORT, press ESC before you finish the VIEWPORT command. The default VIEWPORT is the full screen, or (if you have invoked the WINDOW command) the area within the WINDOW. When the VIEWPORT is set to the full screen, no corner marks appear.

The VIEWPORT command <u>always</u> leaves you in DRAW mode with the PEN COLOR unchanged.

A BRILLIANT REDUCTION



Once you've set a VIEWPORT, you can use the REDUCER function to shrink the entire Tablet working area into the VIEWPORT on the screen. This allows you to convert large pen motions on the Tablet into small motions on the screen. This lets you make precise, small drawings. When you use the REDUCER in conjunction with the DOTS mode, you can modify very small areas of a picture, setting and resetting individual dots if necessary.

Once the REDUCER is enabled, it will stay in effect until you remove it or change the VIEWPORT. To use the REDUCER, set a VIEWPORT around the area in which you wish to work, then press the pen to the square marked REDUCER. When you hear the Apple beep, the REDUCER is active. If you receive the message

NOT POSSIBLE.

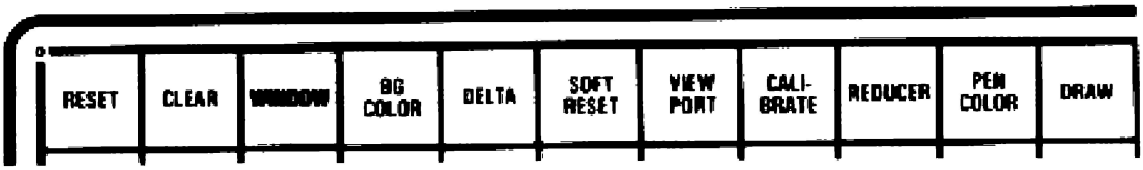
then you have specified a VIEWPORT which is too small or too disproportionately shaped for the REDUCER to function. Such an impossible reduction will leave you with the REDUCER inactive and everything else unchanged.

The screen position of the VIEWPORT determines the minimum possible size into which you can REDUCE. You can REDUCE into smaller VIEWPORTS in the upper-left corner of the screen than in the lower-right corner. Specifically, the smallest possible VIEWPORT size into which you can REDUCE ranges from two screen dots square (at the normal WINDOW setting) in the upper-left corner to 45 dots square in the lower-right.

To disable the REDUCER, press the pen to the REDUCER square again. The Apple will beep and the REDUCER will be disabled. The RESET, SOFT RESET, WINDOW, VIEWPORT, and LOAD commands also disable the REDUCER.

When the VIEWPORT is at its default setting, the REDUCER has no effect.

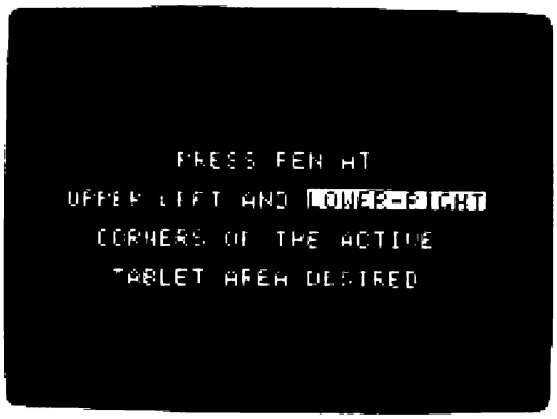
OPENING THE WINDOW



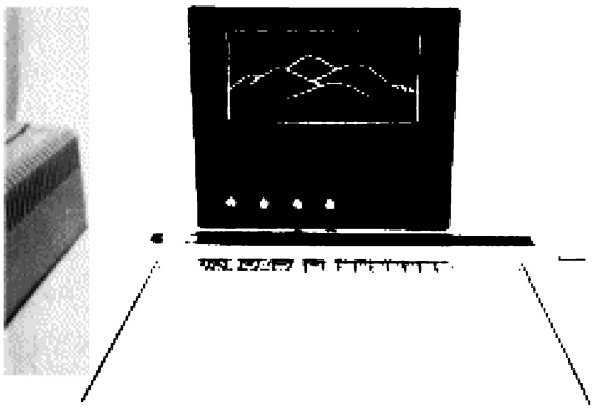
The WINDOW command works like a VIEWPORT with the REDUCER on, but the other way 'round. Where VIEWPORT with REDUCER lets you draw something large on the Tablet, and have it appear smaller and in a specific place on the screen, the WINDOW lets you draw something small in a specific place on the Tablet and have it appear large on the screen.

You normally set a WINDOW before you begin drawing a picture. Press the pen to CLEAR and then to WINDOW. This will appear on the screen:

Find a picture of a molehill and tape it to the Tablet's working area. Now take a pen or a pencil (not the Tablet's pen!) and draw a box around the significant part of the picture. Take the Tablet's pen and, following the highlighted instructions on your screen, press it to the upper-left corner of the box. The highlighting will shift:



Press the pen to the lower-right corner. The words will disappear and the drawing screen will return, with a large frame in the middle of the screen. This frame is proportional to and corresponds with the frame around the molehill on the Tablet, and is centered on the screen. Take the pen, set DRAW mode, and trace the molehill. You will make a mountain on your screen out of the molehill taped to the Tablet.



After it's finished, WINDOW returns you to DRAW mode, with your PEN COLOR unchanged and the VIEWPORT set to the same size as the WINDOW frame on the screen.

The reason that you aren't shown the screen and crosshairs while you set the WINDOW (as you are when you set a VIEWPORT) is that you're selecting an area on the Tablet, not the screen. The resulting area on the screen is as large as the Apple can make it, proportional in size to the WINDOW on the tablet, and centered on the screen. Since the WINDOW area on the Tablet bears little relation to the screen before it's set, the screen and crosshairs are not displayed.

At any time after you have initiated the WINDOW command and before you have completed it, you can use the Apple's keyboard to indicate that you want the default WINDOW, (the entire working area of the Tablet,)

or that you want to cancel the WINDOW sequence. Press RETURN at any time during the WINDOW sequence to cancel it; press 0 to select the default WINDOW.

BROKEN WINDOWS

If you receive the message

PLEASE SPECIFY POINTS CORRECTLY!

then you've not specified the two corner points in their proper upper-left, lower-right order, or you've tried to set the WINDOW to an area on the Tablet that's too small. You will be asked to specify both corners again. If you want to cancel the attempted WINDOW, press RETURN.

If the Apple flashes the message

PLEASE STAY WITHIN THE WORK-AREA.

then you've let the pen stray outside the working area of the Tablet's overlay. You will be prompted again to indicate the corner point. To cancel the WINDOW command, press RETURN.

DRAWING IN THE WINDOW

Once you've placed a WINDOW on the Tablet, you can use any of the Tablet's drawing modes (DRAW, LINES, DOTS, FRAME, or BOX) to draw, as long as you stay within that WINDOW.

You can set the VIEWPORT within the WINDOW on the screen. Once you've set it, you can even REDUCE into it, and use the entire Tablet area within the VIEWPORT. When you turn the REDUCER off, you will again be limited to your WINDOW.

Once you've set a WINDOW, the only way to remove the WINDOW frame is to set a new WINDOW or use the Tablet RESET command. No other Tablet command will remove a WINDOW. The REDUCER will allow you to temporarily override the WINDOW; when you turn off the REDUCER, you will be left with the previous WINDOW again. Experiment with using WINDOW and the REDUCER; you'll be surprised at what they can do.

When you specify a WINDOW on the Tablet, the Apple will draw the WINDOW frame on the screen on top of the current picture. The sides of the frame are two dots wide, and the top and bottom are one dot wide. If you set a new WINDOW, the Apple will remove the frame by drawing over it with the BackGround COLOR. The WINDOW command can

therefore destroy parts of your previous picture. Also, even though WINDOW sets the VIEWPORT to the portion of the screen inside the WINDOW frame, the CLEAR command will clear the entire screen, including everything outside the VIEWPORT and the WINDOW frame, and even the frame itself! (The frame will be redrawn after the CLEAR.) If you reset the VIEWPORT to a slightly smaller size than the WINDOW, the CLEAR command will work normally and erase only what is within the VIEWPORT.

The WINDOW information is stored along with the picture information when you SAVE a picture onto diskette. There is no way to avoid saving this information. When you LOAD a picture, the Apple will automatically use the WINDOW setting stored with that picture, if that picture's diskette file name begins with PIC. If it does not, the Apple will use the default WINDOW setting for your Tablet. You can force the Apple to ignore the WINDOW setting stored in a picture file in three ways:

1) Leave the Graphics Tablet Software (see GETTING OUT) and RENAME the file, removing the PIC. prefix from the file name.

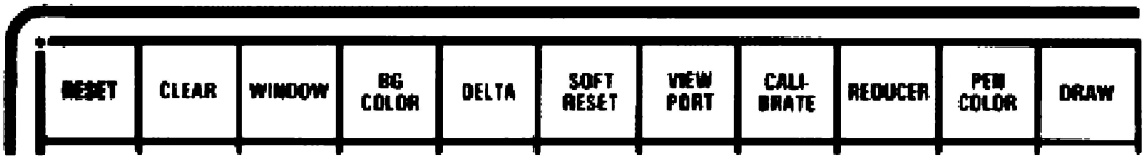
-- or --

2) When you LOAD the picture, type the PIC. flag at the beginning of the picture name. (LOAD PIC.filename)

-- or --

3) Once you have LOADed the picture, press the pen to WINDOW and type [0] to get the default setting.

RESET



The RESET command lets you "wipe the slate clean" and begin anew on a fresh picture. Namely, it:

1) Sets the WINDOW to the the normal 11 inch wide, 6.5 inch tall rectangle at the top of the working area.

2) Sets the VIEWPORT to the full screen.

3) Sets CALIBRATE to one unit per screen dot, and leaves the unit type undefined.

4) Sets the BackGround COLOR to black, and clears the screen.

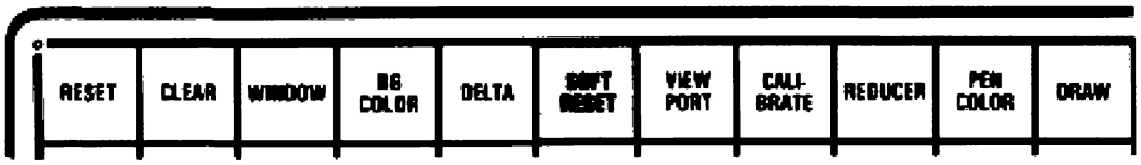
5) Sets the PEN COLOR to white and sets DRAW mode.

6) Sets the value of DELTA to 2 and turns the Audio Feedback feature OFF.

7) Sets the default drive number for LOAD, SAVE, and CATALOG to 1.

Using the RESET command is just like restarting the Graphics Tablet software all over again.

A SOFTER RESET



The SOFT RESET command is a milder version of RESET. It lets you reset many of your drawing and calculating functions, while leaving your picture, WINDOW settings, and pen color intact. SOFT RESET:

1) Sets the VIEWPORT to the full screen, or to the currently set WINDOW. This is the same as pressing D while setting a VIEWPORT.

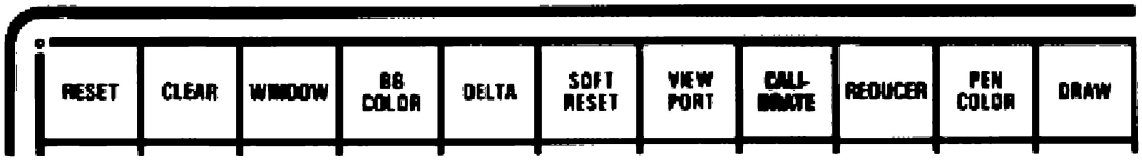
2) Sets the CALIBRATE unit to 1 and the unit type undefined.

3) Sets the DELTA value to 2 and turns the Audio Feedback feature OFF.

4) Sets DRAW mode.

Nothing else is changed by SOFT RESET. The PEN COLOR, BackGround COLOR, the WINDOW setting, the default drive number, and so on, all remain the same.

CALIBRATE



The CALIBRATE command lets you specify a distance on the Tablet surface and use it for measuring with the DISTANCE and AREA functions.

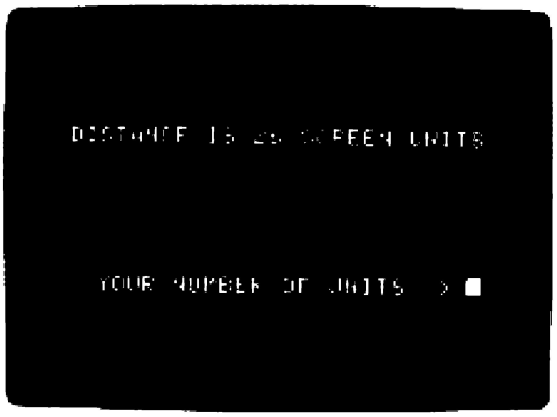
Press the pen to the CALIBRATE square on the menu. The Apple will beep and the brief question:

BEGINNING POINT?

will appear at the bottom of the screen. Select a point and press down. Another brief question:

ENDING POINT?

will flash at the bottom of the screen. Select another point, say, an inch away from the first and press down. The screen will vanish and the following frame will appear:



The Apple has converted the distance between the two points you specified into its internal "screen units". You now have the opportunity to define how long that distance actually was. If you've just arrived from Alpha Centauri, and you specified a distance of about one U.S. inch, then that's about 5 glibbets. Type

You've now defined the length you specified to be 5 Alpha Centauri glibbets. You're free to change it, of course, and give a distance of 10 chronacs, 200 malms, or even half a greton if you so desire (use decimal numbers for fractions, in this case . 5 gretons).

The CALIBRATE command won't let you specify negative distances, or distances greater than 999999999. It also won't let you use a name for your measurement which is more than 10 letters, numbers, or special characters (such as asterisks, bracketts, etc.) long.

You can tell the Apple that you'll agree to use its internal screen units for measurement by answering its questions about length and name with the RETURN key. Once you've specified a distance and unit name in the CALIBRATE command, they will remain as you set them until you: a) reset them with the CALIBRATE command, b) do a RESET or a SOFT RESET, or c) change the BackGround COLOR, the VIEWPORT setting, or the WINDOW setting.

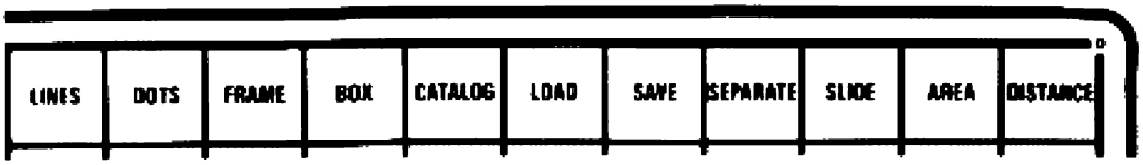
MISTAKEN CALIBRATION

If you specify an endpoint for the CALIBRATE distance which is outside the current VIEWPORT, you will be asked to indicate the point again.

Once you begin to define a distance for the CALIBRATE command, you can cancel the procedure by pressing the RETURN key.

Don't change the REDUCER setting after you've CALIBRATED your Tablet. If you do, it will shrink your measurements just as it shrunk your Tablet movements, and all your DISTANCE and AREA calculations will be incorrect.

LONG DISTANCE...



Once you've set a distance and a unit name with the CALIBRATE command, you can use those definitions to calculate the DISTANCE that you move the pen along a path on the Tablet surface.

For example, find a road map (we'll use one of Central California), unfold it, and tape it to the Tablet so that the legend (with the scale of distance) is in the working area. Use the CALIBRATE command to set the distance and unit name to the scale of distance on the map:

Now point the pen to the DISTANCE square and press down. The Apple will beep, signaling you to take the pen and trace a path on the map. Draw a path from Buttonwillow to Bakersfield, along Route 5. The path

will appear on the screen as you draw. When you lift the pen, the Apple will beep again and flash

CALCULATING...

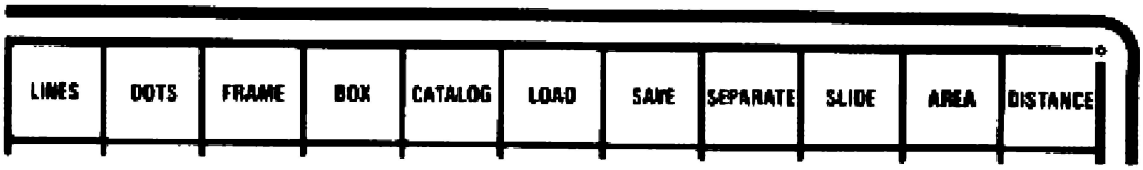
at the bottom of the screen, and then go away and think for a moment. It will soon return, telling you that the DISTANCE you traveled from Buttonwillow to Bakersfield is about 25 miles. After a short delay, you will be returned to DRAW mode.

The path you draw, as it appears on the screen, is just like any other path in DRAW mode, and it is subject to the same DELTA effects as DRAW. Lower DELTA settings will give you more accurate DISTANCEs; higher DELTA settings will give you less accurate (albeit quicker) approximations.

If you invoke the DISTANCE command and then decide you don't want to calculate a distance after all, simply press the RETURN key instead of drawing a path on the Tablet.

There is a limitation on the maximum DISTANCE your path can be. The longest path you can draw for DISTANCE contains 800 points. With a DELTA setting of 2, this is 1600 screen units, or about 59 actual inches on the Tablet. Of course, this will be different if you're using the WINDOW or REDUCER functions.

. . . AND AREA CODES



The AREA command is a counterpart to the DISTANCE command. But instead of letting you find the DISTANCE between Buttonwillow and Bakersfield, CA, it will let you figure the AREA of Manhattan. Quickly remove the map of Central California and switch to one of the New York City area. Use the CALIBRATE command with the scale of distance on the new map.

Now place the pen on the AREA square and press down. The Apple will respond with a beep. Trace the perimeter of Manhattan. As soon as you lift the pen, the Apple will beep again and flash

CALCULATING...

and sit and think for a few moments. Soon it will return with the area of the island, expressed in the units you set in the CALIBRATE command. It will hold this value on the screen for about five seconds, and then return you to DRAW mode.

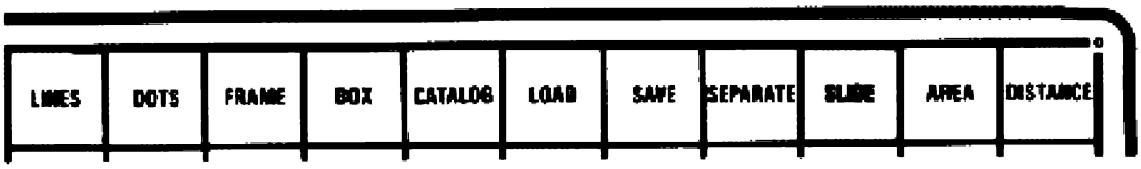
Now CLEAR the screen and try it again. This time, don't go completely around the island, but stop about half an inch away from your starting point. The Apple will obligingly close the curve for you, connecting the ending point directly to the beginnning, before it calculates the AREA.

AREA is subject to the same limitations as DISTANCE: you can only draw a path 800 points long, or about 59 Tablet inches with a DELTA setting of 2. As in DISTANCE, a larger DELTA setting will give you less accurate results. And if you had the REDUCER on when you CALIBRATED, don't turn it off when you are going to calculate an AREA. A press of the [redacted] key will abort the AREA command, just as it will for the DISTANCE command.

Now CLEAR the screen and find the AREA of Manhattan again. This time, go around the island twice. Notice that even though the AREA looks the same on the screen, the number that the Apple will return is about twice the actual AREA of the figure. This is normal: if you go around three times, the Apple will give you a number three times too large, and so on.

If, while drawing around an AREA, you move the pen outside the VIEWPORT, the Apple will act as if you had lifted the pen at that point, close the curve, and figure the AREA.

SLIDE RULES



Once you've got a picture on the screen, you don't have to rest at that. No, you can mobilize your pictures, give them some motivation, see some action! Press the pen to the SLIDE square. The request

BEGINNING POINT?

will appear briefly at the bottom of the screen. Use the pen to select any point on your picture, and press down. A second request

ENDING POINT?

will appear. Select another point on the screen, some distance removed from the first. Watch your picture travel across the screen, both vertically and horizontally, until the first point you selected (on the picture) is in the vicinity of the second point (on the screen).

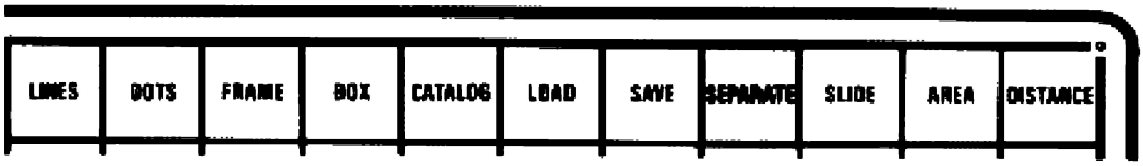
If you decide that a SLIDE isn't what you want right now, press [redacted] to cancel the operation. You'll be returned to your picture, in DRAW mode.

The SLIDE operation is performed in four directions, with what mathematicians call "toroidal wrap-around". This ponderous phrase means that the picture thinks it's not on a flat screen, but wrapped around a doughnut: the left side is joined to the right side, and the top is joined to the bottom, so that everything that you SLIDE off one edge of the screen will reappear on the opposite edge. When your SLIDE is complete, you will be returned to DRAW mode.

SLIDE moves the entire screen: there is no way to move only a portion of the screen. Because of the way the Apple places colors on the screen (see A SHORT DIGRESSION...), the SLIDE command can move the picture the exact vertical distance you indicate, but can only come within 14 dots of the horizontal location you specify.

SLIDE will remove the VIEWPORT and WINDOW borders before it moves the picture, but will replace them in their former locations (not SLID over) after the SLIDE is complete.

PRISMATIC APPLE



The SEPARATE function "strips" your picture, until only one color is left. Press the pen to the SEPARATE square. You will be presented with a color menu, just like in PEN or BackGround COLOR. REMEMBER: The SEPARATE command will destroy parts of your picture. If you want to preserve a picture, be sure to SAVE it before you do a SEPARATE. If you've already started a SEPARATE command, just press [redacted] to cancel it and return you to DRAW mode.

If you do want to SEPARATE out your picture, select a color from the color menu with the pen and press down. The menu will vanish and your picture will reappear. Quicker than you can pronounce "refraction", your picture will be stripped of all colors except the one you selected. You will be left in DRAW mode, with your BackGround COLOR set to black and your PEN COLOR set to the SEPARATE color you specified.

There is no way to undo a SEPARATION. The SEPARATE command will remove any VIEWPORT or WINDOW before it performs its function, and restore them when it's finished. SEPARATE works only on the entire screen: there is no way to SEPARATE only a portion of the screen.

You cannot SEPARATE out the color black. If you did, you'd be left with a blank screen! The Apple will deny your attempt to separate out either of the blacks with the message

NO SEPARATION ON BLACKS.

IN CONCLUSION

Congratulations! If you've come this far, and practiced with your Tablet along the way, then you've mastered the basic functions of the Apple Graphics Tablet. With a little practice, you can be drawing and manipulating pictures with skill and ease. If you're interested in doing more with your Tablet, and you're accustomed to programming in Applesoft BASIC, then you might be interested in looking into Chapter 3. It describes the internal operation of the Graphics Tablet software, and the operating subroutines in the Graphics Tablet itself. You'll find dozens of new applications for your Tablet. Go ahead, keep drawing, and have fun!

CHAPTER 3
PROGRAMMING THE GRAPHICS TABLET

THE PROGRAMS

There are four main programs which comprise the Graphics Tablet software. Three of these programs are supplied on your GRAPHICS TABLET SOFTWARE diskette, and the fourth is stored in ROM (Read-Only Memory) on the Tablet Interface card. These programs are:

1) TABLET-CODE APPLESOFT: This is a large applications program, written in the Applesoft II BASIC programming language. This is the program which performs all the commands and functions of the Tablet as described in Chapter 2.

2) QUICK-DRAW: This is a machine language subroutine which is used by the TABLET-CODE APPLESOFT program. This subroutine allows an Applesoft program to draw lines on the Apple's high-resolution graphics screen as fast as the Tablet can supply the points. This machine-language subroutine is hidden inside an Applesoft program.

3) Tablet Firmware: This is a set of subroutines permanently stored in ROM on the Tablet's Interface card. These are base-level subroutines for the basic operation of the Tablet. They can be used from any Apple programming language.

4) UTILITIES: This is a package of machine-language subroutines which perform many of the screen manipulation functions of the TABLET-CODE program. This package includes the subroutines which perform the SEPARATE and SLIDE operations. It also includes the shape table used by the Applesoft DRAW command to draw the corner marks for the VIEWPORT. These subroutines are stored in a binary file on the diskette and load at location $6000 (decimal 24576) in memory. The length of this file is $330 (816 decimal) bytes.

In addition, there are two other Applesoft programs which are used as part of the Graphics Tablet software package, but don't take part in the actual operation of the Tablet. They are:

1) HELLO: This is the program which is executed when you boot the diskette. It is also executed whenever you exit the TABLET-CODE or MENU ALIGNMENT programs. It allows you to select which program you wish to run, and lets you quit if you want to.

2) MENU ALIGNMENT: This is another Applesoft program that sets up an information file on the diskette, called TAB.INFORMATION . This file contains information about what slot the Interface card is in and where the overlay is located on the Tablet.

TABLET-CODE APPLESOFT

This is the main operating program for the Graphics Tablet. It is written in Applesoft, and takes up 12K bytes of the Apple's memory. It resides between locations $1000 and $3FFF (decimal 4096 and 16383) of memory. It requires that your Apple have the Applesoft language in ROM or on a Language System Language card. It will not run with cassette or diskette versions of Applesoft.

A source listing of this program appears in Appendix D, along with an atlas of subroutines, variables, and special locations. Here is a brief map to the program:

Lines	Function
10-160	Initialization. This section reads the Tablet information file, sets up all pertinent Tablet parameters, and initializes and clears Page 2 of the Apple's high-resolution graphics screen. It also places the program and its variables in the proper locations in the Apple's memory, and loads the UTILITIES subroutines.
170-180	This is the main DRAW mode loop. These two lines take input from the Tablet pen and send it to the QUICK-DRAW subroutine to draw on the screen. The only way out of this loop is to press a key or press the pen outside the Tablet's working area (i.e., on the menu).
190-194	These lines are executed when you press a key during DRAW mode. If you press any key other than [redacted], nothing happens. If you press [redacted], you will be asked whether you wish to quit or not. Pressing any key other than [redacted] will return you to DRAW mode. Otherwise, the HELLO program will be run.
200-290	These lines sense when you press the pen to the menu. Line 280 is the main menu vector table.
300-310	The CLEAR command.
330-410	The LOAD command.
420-520	The SAVE command.
530-540	A subroutine to input the disk drive number during LOAD, SAVE, and CATALOG.
550-560	The SOFT RESET command.
570-610	The CATALOG command.

620-640	The BackGround COLOR command.
650	The PEN COLOR command.
660	This line lets you reenter LINES, DOTS, BOX, or FRAME mode after a menu selection.
670-870	This subroutine draws the color menu for BackGround COLOR, PEN COLOR, and SEPARATE, and lets you select a color with the pen.
880	Color box low-resolution draw.
890-1120	The WINDOW command.
1130-1140	This subroutine resets the Tablet WINDOW information after a color menu selection.
1150-1290	The VIEWPORT command.
1300	This subroutine causes a 1.15 second delay. It is used to pause while the Apple is displaying a message on the screen.
1310-1320	This subroutine waits until either a key is pressed on the keyboard or the pen is pressed down, and then returns.
1330-1340	This subroutine draws or undraws the four corner marks for a VIEWPORT.
1350-1360	This subroutine draws a single VIEWPORT corner mark.
1380-1390	The REDUCER command.
1400-1440	Turns on the REDUCER.
1460-1560	The DELTA command.
1580-1660	LINES mode.
1680-1720	DOTS mode.
1740-1820	FRAME mode.
1840-1930	BOX mode.
1940-1950	This subroutine is called whenever you specify a point outside of the VIEWPORT for any of the four modes mentioned above.
1970-1980	The AREA command. This section is the drawing loop.

1990-2030	The calculation section for AREA.
2070-2080	The DISTANCE command. This section is the drawing loop.
2090-2120	The calculation section for DISTANCE.
2160-2290	The CALIBRATE command.
2300	A subroutine to blank out the four lines at the bottom of Page 2 of Text mode.
2310	A subroutine to display "BEGINNING POINT?" at the bottom of Page 2 of Text mode and wait for the pen to be pressed down.
2320	A subroutine to display "ENDING POINT?" at the bottom of Page 2 of Text mode and wait for the pen to be pressed down.
2330-2480	The SLIDE command.
2490-2580	The SEPARATE command.
2590-2600	This subroutine resets the Tablet firmware.
2610-2730	Error handling subroutines.

THE MAIN LOOP

The main programming loop of the TABLET-CODE program occurs in lines 170 through 290. Lines 170 and 180 are the main loop for the DRAW mode. The DRAWing is done by the CALL EP% in line 170. This activates the QUICK-DRAW subroutine, which reads the Tablet and draws on the screen. As it draws on the screen, it also places the coordinates for each point plotted into the two arrays called X% and Y%. It uses the variable N% as an index into these arrays, and uses the value of the variable D% as its DELTA value (see the section on the QUICK-DRAW subroutine). The QUICK-DRAW subroutine returns to the Applesoft program when one of four events occur:

1) A key on the keyboard was pressed.

2) The pen was pressed down outside the working area of the Tablet.

3) The pen was lifted after being pressed down.

4) One of the arrays X% or Y% was filled up.

When QUICK-DRAW terminates, the termination condition code (a number from 0 to 3) is stored in location 700, and the Applesoft program

places this value into the variable CD. Depending upon the termination condition, the program either reinitializes the DRAW mode, or branches to line 190 (to handle a keypress) or line 200 (to get a menu selection).

If the pen was pressed outside the working area, then lines 220 through 240 sense the pen's position again in relation to the menu. Two numbers are returned: X holds a number from 0 to 21 which corresponds to one of 22 horizontal positions across the menu, and Y holds a number (0 or 1) which corresponds to one of two menu rows.

The ON Y+1 GOTO 280,290 statement in line 250 selects between the top and bottom menu rows. The ON X+1 GOTO 140... in line 280 selects among the 22 menu items in the top row.

MENU ITEMS

Each menu item corresponds to a block of code (not a subroutine) in the program. After the code for each item performs its function, it executes either a GOTO 170 (to reinstate DRAW mode) or a GOTO 660 (to reenter the current mode). A list of the variables which are used in the program and a description of their function appears in Appendix B. Subroutines which are called by parts of the program also appear in that Appendix.

The four other modes (LINES, DOTS, BOX, and FRAME) are actually independent menu items which operate differently from DRAW mode. For an example, look at the code for the FRAME mode, in lines 1740 through 1820. Line 1740 resets the Tablet to accept points from the current WINDOW area, with a sparkling crosshairs cursor displayed. It also sets the variable CM (for Current Mode) to 3, for FRAME mode. Line 1750 loops until the pen is pressed onto the Tablet surface, and returns the coordinates of the point in X and Y. These coordinates can be used directly to plot onto the high-resolution screen.

Line 1760 checks to see if the point is inside the current VIEWPORT. If it is not, the subroutine at line 1940 is called. This subroutine checks that the point is in the menu area. If it is, it sets the variable RT to 1; if not, it sets RT to 0 and displays the message

POINT OUTSIDE VIEWPORT. RESPECIFY.

Back in line 1760, if a menu item was selected, the code causes a jump to line 220 (menu selection). If the point was outside the viewport, the mode is restarted by a GOTO 1750.

If the point was inside the VIEWPORT, then line 1780 plots the point on the screen and saves its coordinates in the variables TX and TY. Lines 1790 through 1810 go through the whole get-a-point procedure again, and get another point in X and Y. Finally, line 1820 actually draws the FRAME, and jumps back to line 1750 to get another two points.

EXTENDING THE MENU

If you can write programs for the Apple, then you can tailor the TABLET-CODE APPLESOFT program to your own liking. You can add extra functions and remove or modify existing functions. You can define your own menu selections, or you can even start from scratch and write your own programs to use the Graphics Tablet to do just about anything.

The TABLET-CODE APPLESOFT program uses almost all of the memory space allotted for it. If you wish to add a function to the code, you must delete some of the program to make room for it. If the program grows any larger, it will not work.

EXAMPLE: INSTANT COLOR MENU

If you're tired of having to wait for the Apple to redraw the color menu when all you want to do is change the PEN COLOR from white to black, here's a modification you can make to get instant changes in PEN COLOR. To do it, you'll have to sacrifice one of the Tablet's other functions. Since this will mean changing your TABLET-CODE program, it's important that you not work on the original backup diskette.

Type

```
NEW
LOAD TABLET-CODE APPLESOFT
```

to load the unmodified program. To make room for your new code, delete a function you don't use much (some good candidates for oblivion are SLIDE, SEPARATE, AREA, DISTANCE, and CALIBRATE -- they are special-purpose functions and their removal won't affect the rest of the program). Let's delete the SLIDE function. Type

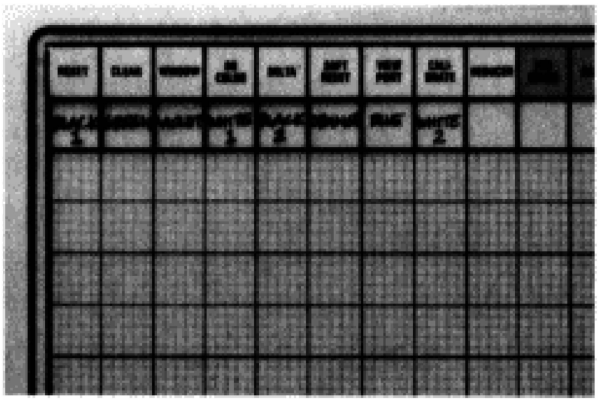
```
DEL 2330,2480
```

Now you've got about 250 more bytes to use for your program. To replace the SLIDE command with a null command, enter the line

```
2330 GOSUB 1130: GOTO 170
```

to reset the Tablet and return to DRAW mode if you try to select the now-defunct SLIDE function.

What we'll do is let you choose a new PEN COLOR simply by poking one of the first eight squares in the second row of the menu. Label these squares on your menu with a pencil or pen:



Now for the programming part. In lines 250 through 280, the variables X and Y hold the coordinates of the menu box which was just selected. Y is set to 0 for the top row and 1 for the bottom, and X holds a number between 0 and 21 corresponding to the 22 boxes in each row. So, if you poke the pen to one of the eight boxes of the new color menu, Y will be set to 1 and X will be a number from 0 to 7, depending upon which of the 8 squares you poked. It just so happens that the eight colors in Applesoft's high-resolution graphics mode are numbered 0 through 7, and they are in the exact same order as the color names you wrote on the second row of the menu! Isn't that lucky? But, first we've got to handle Y. In line 250, if Y is equal to 1, the program goes to line 290, the null function. Let's replace that line with

```
290 IF X<0 OR X>7 THEN GOSUB 1130: GOTO 170
```

Now the null function is executed only if the pen was pressed in the second row and not in the first eight boxes. If the pen was pressed in one of the first eight boxes, the next line will be executed. So let's make the next line:

```
295 PC=X: HCOLOR=PC: GOSUB 1130: GOTO 660
```

This line sets the Pen Color to the value of X (remember, 0 through 7?) and sets the high-resolution COLOR to that value. Then it resets the Tablet and goes to line 660, which reenters the current mode.

And that's it! Now before you RUN it save this version onto a copy of the GRAPHICS TABLET SOFTWARE diskette. You might want to add a REM statement at the beginning, describing the change and date. When you SAVE the program, you must save it under the name TABLET-CODE APPLESOFT or you won't be able to use it. Since the version of TABLET-CODE APPLESOFT that is on your diskette is LOCKed, you will have to UNLOCK it before you can save the new version.

To use your newly modified program, type

```
RUN HELLO
```

press [redacted], select [redacted], and press [redacted]. When the program is running, you can instantly change colors in midstream, from any mode, by pressing the pen to the box for that color.

EXAMPLE: CIRCLE MODE

Here's another change which is a little more extensive than the previous one. Here are two extra modes, counterparts to BOX and FRAME, which draw open and filled circles rather than rectangles. You'll specify the location and size of a circle by poking two points on the Tablet: the first one will be the center of the circle and the second will be on the perimeter. Since this will require some extra room, (if you haven't done it already) delete a function such as SLIDE. In fact, you can delete both SLIDE and SEPARATE and use their menu squares to set CIRCLE and DISC mode. On a copy (not either of your original copies) of the GRAPHICS TABLET SOFTWARE diskette, type

```
LOAD TABLET-CODE APPLESOFT
DEL 2330,2580
```

Now they're gone. Since CIRCLE and DISC need two points, just like BOX and FRAME, we can follow the example of those modes. Type

```
2330 REM ** CIRCLE MODE **
2340 GOSUB 1130: PRINT D$;"IN#";SL: CM=5
2350 RT=2: INPUT X,Y,Z: IF Z<>2 THEN POKE -16368,0: GOTO 2350
2360 IF X<X3 OR X>X4 OR Y<Y3 OR Y>Y4 THEN GOSUB 1940: IF
     RT=1 THEN 220
2370 IF RT=0 THEN 2350
2380 HPLOT X,Y: TX=X: TY=Y
2390 RT=2: INPUT X,Y,Z: IF Z<>2 THEN POKE -16368,0: GOTO 2390
2400 IF X<X3 OR X>X4 OR Y<Y3 OR Y>Y4 THEN GOSUB 1940: IF RT=1 THEN 220
2410 IF RT=0 THEN 2390
```

At this point, the coordinates of the center of the circle are in TX and TY, and the coordinates of a point on the perimeter are in X and Y. Let's find the radius of the circle now:

```
2420 R=SQR((X-TX)^2+(Y-TY)^2)
```

With a little trigonometry, we know that the horizontal and vertical distance from the center of a circle to any point on the perimeter is given by the simple formulae

```
2440 DX=R*SIN(TH): DY=R*COS(TH): X=TX: Y=TY
```

where R is the radius (derived in line 2420) and TH is an angle from 0 to 2*pi. Furthermore, we know that this formula gives us not one, but eight points on the circle:

```
X+DX,Y+DY       X+DX,Y-DY       X-DX,Y+DY       X-DX,Y-DY
X+DY,Y+DX       X+DY,Y-DX       X-DY,Y+DX       X-DY,Y-DX
```

as TH ranges from 0 to pi/4 where X,Y is the center of the circle. So, let's add a loop and the lines to plot the points on the perimeter.

```
2430 FOR TH=0 TO .7854 STEP 1/R
2450 HPLOT X+DX,Y+DY: HPLOT X+DX,Y-DY: HPLOT X-DX,Y+DY:
     HPLOT X-DX,Y-DY
2460 HPLOT X+DY,Y+DX: HPLOT X+DY,Y-DX: HPLOT X-DY,Y+DX:
     HPLOT X-DY,Y-DX
2470 NEXT Th: GOTO 2350
```

Now to finish it all up, change the lines

```
660 ON CM+1 GOTO 170,1580,1680,1740,1840,2330
1380 RD=RD+1: IF RD>1 THEN RD=0: GOSUB 1130: GOTO 660
1390 GOSUB 1400: GOTO 660
```

These changes let you go back to CIRCLE mode automatically after making a menu selection.

Now UNLOCK the old version of TABLET-CODE APPLESOFT that is on your diskette, (the one on which you're putting your own versions) and then SAVE this new version on your diskette. RUN HELLO and start using the GRAPHICS TABLET SOFTWARE. When you want to draw an open circle, press the pen to the square marked SLIDE. Indicate one point for the center of the circle, and another for a point on the perimeter. The circle will be drawn to specification, and you'll remain in CIRCLE mode until you choose another.

Be forewarned that if you make a CIRCLE which is too large for the screen, then you'll get an error. Just press [redacted] to get back to DRAW mode. If you don't like this "feature", the following lines will fix the problem:

```
2425 ON ERR GOTO 2480
2470 NEXT TH: ON ERR GOTO 2650
2475 GOTO 2340
2480 PRINT D$;"PR#0": GOSUB 2300: PRINT D$;"PR#";SL: PRINT "M2":
     VTAB 23: HTAB 12: POKE 41, PEEK(41)+4: PRINT "CIRCLE OFF SCREEN.
     RESPECIFY."
2485 GOSUB 1300: PRINT D$;"PR#";SL: PRINT "N,H2": ONERR GOTO 2650
2490 GOTO 2340
```

Note that you can still make circles which go out of the VIEWPORT. There's no easy way to prevent this.

EXAMPLE: DISC MODE

The DISC mode is just the same as CIRCLE mode, except that instead of plotting individual points on the perimeter, you'll have to draw lines across the diameter to fill in the circle. Because they have so much code in common, you can make DISC use much of the code from CIRCLE. Here are the changes to CIRCLE to make it do DISCs, too:

```
2340 CM=5: GOTO 2348
2342 REM ** DISC MODE **
2344 CM=6
2348 GOSUB 1130: PRINT D$;"IN#";SL

2445 IF CM=6 THEN 2464
2462 GOTO 2470
2464 HPLOT X+DX,Y+DY TO X-DX,Y-DY: HPLOT X+DX,Y-DY TO X-DX,Y+DY
2466 HPLOT X+DY,Y+DX TO X-DY,Y-DX: HPLOT X+DY,Y-DX TO X-DY,Y+DX
```

To change the menu vector table so that the SLIDE square will activate CIRCLE and the SEPARATE square will activate DISC, change line 280 to read:

```
280 ON X+1 GOTO 140,300,890,620,1460,550,1150,2160,1380,650,290,1580,
    1680,1740,1840,570,330,420,2342,2330,1970,2070
```

and make this other change:

```
660 ON CM+1 GOTO 170,1580,1680,1740,1840,2330,2342
```

This next line lets you reenter both CIRCLE and DISC modes after you make a menu selection (such as PEN COLOR). Finally, if you added the error handling subroutine described above, then change it so:

```
2390 ON CM-4 GOTO 2330,2342
```

Now again SAVE your modified program under the name TABLET-CODE APPLESOFT on the diskette you're using for your experimentation.

THE FIRMWARE

On the Graphics Tablet Interface card is a 2K byte ROM (Read-Only Memory). This ROM contains all the subroutines which read and interpret the signals from the Graphics Tablet. These subroutines can be used easily from any BASIC program.

The Graphics Tablet Firmware performs many functions. Its main purpose is to read the position of the Tablet's pen on the surface of the Tablet, and return that position in a numerical form to a BASIC program. But, it also does much more:

- It lets you supply horizontal and vertical offset information. It will use this offset information in calculating the pen position. This lets you place the origin (where the X and Y coordinates are both 0) anywhere on the Tablet surface. The offsets can be integers from -32767 to +32767.

- It allows you to give a scaling divisor, from 1 to 32767. You can tell the Tablet firmware to divide all coordinates by this number before it passes them to your BASIC program. This lets you calibrate the Tablet units (200 to the inch) to your own scale.

- It allows you to select among ten different modes on the Apple's screen. Text, low-, and high-resolution graphics (on either Page 1 or Page 2) can be selected, and you can mix text with graphics.

- It automatically displays a flashing cursor on the Apple's screen, given the proper scaling and offset information. Cursors are available or may be supressed in all screen modes.

- You can tell the Tablet to supress all output from your Apple.

- You can read not only the position of the pen, but also whether it is within readable distance, whether the pen is up or pressed down, detect pen-down and pen-up movements, and read the keyboard to see if a key has been pressed.

Your programs can communicate to the Firmware subroutines by using the BASIC commands PR# s and IN# s , where s is the number of the peripheral connector slot in the Apple which holds the Tablet Interface card. (The PR# command indicates that all subsequent output is to be directed to the Firmware subroutines in a certain slot, and the IN# command indicates that all subsequent input is to be taken from the Firmware subroutines in the given slot.) When your program wants to stop talking to the Firmware subroutines, it can issue a PR#0 or IN#0 command to direct output or accept input from the normal screen and keyboard.

To avoid alienating DOS (the Disk Operating System), you'll have to issue the PR# and IN# commands in the form of DOS commands. See the section on Selecting I/O Devices in your DOS manual.

TABLET CONTROL

To send control information to the Tablet, just execute a PR# 8 command from BASIC and PRINT a string of Tablet Control commands. The Control commands will not be displayed on the Apple's screen: they will be used by the Tablet alone.

There are seventeen Tablet Control commands. These commands take the form of a letter or a word, sometimes followed by a number. Commands are executed in a sequential order as given to the tablet by the user.

Commas are used as delimiters between commands and must not begin or end the command string. Spaces are ignored. A null string issued to the tablet is invalid. Only the first alphabetic character of a command is meaningful; the other alphabetic characters are ignored and may be omitted.

Following is a list of Tablet Control commands. The letter "n" that follows some of these commands represents an integer. The Tablet Control commands are:

TEXT n	Sets the Apple's screen to show text mode. n determines which page of Text to display and can be either 1 or 2.
HGR n	Sets the Apple's screen to show full-screen high-resolution graphics mode. n determines which page of graphics to display and can be either 1 or 2.
LGR n	Sets the Apple's screen to show full-screen low-resolution graphics mode. n determines which page of Graphics to display and can be either 1 or 2.
MIXHGR n	Sets the Apple's screen to show high-resolution graphics mode, mixed with four lines of text at the bottom. n determines which page of text and graphics to display and can be either 1 or 2.
GR n	Sets the Apple's screen to show low-resolution graphics mode, mixed with four lines of text at the bottom. n determines which page of text and graphics to display and can be either 1 or 2.

SCALE n	Sets the Tablet scaling divisor to n. All coordinates generated by the Graphics Tablet will be divided by n before they are given to your program. The range for n is 1 to 32767. If you give the Tablet a negative scaling divisor, it will ignore the minus sign and use the positive number. A scale factor of 0 is undefined and will not work.
XOFF n	Sets the Tablet horizontal (X) offset to n. If the R command is enabled, all horizontal coordinates will have n added to them before they are given to your BASIC program. The offset value, n, may range from -32767 to +32767.
YOFF n	Sets the Tablet vertical (Y) offset to n. If the R command is enabled, all vertical coordinates will have n added to them before they are given to your BASIC program (see R command below). The offset value, n, may range from -32767 to +32767.
P	Ignore scaling divisor. None of the coordinates generated by the Tablet will be scaled or offset. The cursor, however, will not ignore scale and offset information.
R	Use scaling divisor. All coordinates generated by the Tablet will be divided by the scaling divisor before they are given to your BASIC program. Then offset values will be added.
AFTER	If the R command is used, the offsets will be added after the scaling operation. This command is turned off (the BEFORE command is reinstated) with any subsequent command which sets a screen mode, including the DEFAULT command.
BEFORE	If the R command is used, the offsets will be added before the scaling operation.
NOPRINT	Disables all on-screen printing. After a NOPRINT command is sent to the Tablet, no new output generated by the Apple will be displayed on the screen. NOPRINT mode is turned off by any other Tablet Control command string or by a BASIC PR#0 command.
CURSOROFF	Turns off the sparkling cursor. The cursor will remain off until any other Tablet Control command is sent which sets a screen mode (the DEFAULT command also turns the cursor on).
P	Sets Stream mode. If the pen is within the proximity of the Tablet, the Tablet Firmware will send coordinates each time it is polled, regardless of the pen position or status. This command is turned off (the Q command

is reinstated) with any subsequent command which sets a screen mode, including the DEFAULT command.

Q — Resets Stream mode. The Tablet firmware will send coordinates only when it is polled, and the pen is pressed down.

DEFAULT — Sets the standard (default) Tablet mode:

- HGR 2 screen mode
- SCALE=16
- XOFF=1536
- YOFF=1536
- F (no scaling or offsets)
- BEFORE
- Q (stream mode off)
- Cursor on
- Printing on

For example, if the Tablet Interface card is in slot number 5 and you want the Tablet to set low-resolution graphics mode, with four lines of Text at the bottom, use a scaling divisor of 16, and use the offsets stored in the variables XO and YO, and apply them before the scaling, you would use this Tablet Control command:

```
PR#5: PRINT "GR 1, SCALE=16, XOFF=";XO;", YOFF=";YO;", BEFORE":PR#0
```

Of course, you could shorten it by eliminating extraneous spaces and using only the first letter of each Control command name:

```
PR#5: PRINT "G1,S16,X";XO;",Y";YO;",B":PR#0
```

Since you are using Apple DOS, you must use DOS's PR# command in order to use both DOS and the Tablet. If you've got the slot number of the interface card in the variable SL, then the same Tablet Control command would read:

```
PRINT D$;"PR#";SL:PRINT "G1,S16,X";XO;"Y";YO;",B":PRINT D$;"PR#0"
```

It's important <u>not</u> to add a semicolon (;) or comma (,) at the end of the Tablet Control PRINT string. The Tablet will execute the command only when it receives a RETURN character. A semicolon or a comma after the string will suppress the RETURN; therefore, the Tablet will never carry out your commands because it won't hear the end of them.

Any illegal construct in a Control command, including numbers out of range, will cause the screen to return to text mode and the message

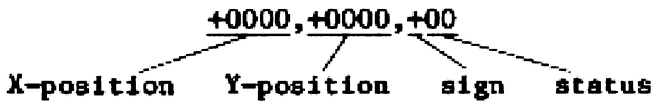
```
*** TABLET SYNTAX ERROR
```

to appear on the screen.

ACCEPTING INPUT

Once you've told the Tablet what kinds of numbers you expect to be getting from it, you can use the BASIC statements IN# and INPUT to get the pen coordinates and status information from the Tablet.

The Tablet sends its coordinate and status information in this format:



The X- and Y-position coordinates must be integers from -9999 to +9999. The user is responsible for adjusting the X and Y offsets and the scale value so that values returned by the tablet fall within this range. It is possible to exceed this range, in which case an Applesoft error will be generated. These coordinates indicate the position of the pen on the Tablet. If the R command is in effect, these coordinates indicate the position of the pen plus the offset and divided by the scaler.

The sign and status digits indicate the status of the pen and keyboard. If the sign is negative, then a key has been pressed. The two digits have separate meanings:

Tens digit:	Ones digit:
0 = pen is on scale	0 = pen is down, and has been down
1 = pen is off-scale	1 = pen was just lifted
	2 = pen was just pressed down

So let's write a program to read the Tablet and print out the coordinates, without scaling or offsets, on the Text screen. Let's assume that the slot number of the Interface card is stored in the variable SL.

```
100 PR#SL: PRINT "T1, F, C, P": PR#0: REM INITIALIZE TABLET
110 IN#SL: INPUT X,Y,Z: IN#0: REM READ TABLET
120 PRINT "THE X-POSITION IS ";X;", THE Y-POSITION IS ";Y;"."
130 IF Z<0 THEN PRINT "THE KEYBOARD HAS BEEN PRESSED."
140 IF ABS(Z)>=10 THEN PRINT "THE PEN IS OFF-SCALE."
150 Z=ABS(Z): IF Z>=10 THEN Z=Z-10: REM GET ONES DIGIT
160 IF Z=0 THEN PRINT "PEN IS DOWN."
170 IF Z=1 THEN PRINT "PEN WAS JUST LIFTED."
180 IF Z=2 THEN PRINT "PEN WAS JUST PRESSED DOWN."
190 PRINT
200 POKE -16368,0: GOTO 110:REM CLEAR KEYBOARD STROBE, REPEAT
```

This program will work in either Applesoft BASIC or Apple Integer BASIC.

Line 100 sets the Tablet Control parameters. Line 110 gets input from the tablet, and the remaining lines interpret the values and print an explication. Line 200 clears the keyboard strobe (if a key was pressed) and loops back to get another set of values.

This program works in Stream mode, that is, it is continually getting input from the Tablet regardless of the position of the pen. If you change the Tablet Control command string to read

```
100 PR#SL: PRINT "T1, F, C, Q": PR#0
```

then the coordinates will be returned only when the pen is pressed down.

Let's write a subroutine in BASIC which is to return the X and Y coordinates of the next pen press, or return with the variable KY set to 1 if the user presses the RETURN key on the keyboard. Let's assume that the Tablet has been initialized in the main program (see previous example, line 100).

```
200 REM ** SUBROUTINE TO GET A PEN PRESS OR KEYPRESS **
210 KY=0: REM FLAG FOR KEYPRESS
220 IN#SL: INPUT X,Y,Z: IN#0
230 IF Z=2 THEN RETURN: REM PEN DOWN
240 IF Z>0 THEN 280: REM NO KEYPRESS
250 K=PEEK(-16384): REM GET KEYPRESS
260 IF K<>13 THEN 280: REM IS IT A RETURN?
270 KY=1: RETURN: REM YES, IT IS.
280 POKE -16368, 0: GOTO 220: REM NO, KEEP LOOKING.
```

FROM MACHINE LANGUAGE

You can perform the same Tablet operations from within a machine language program that you can from a BASIC program. Even though machine language programs are a little more difficult to write, they will run faster and use less memory than their BASIC counterparts.

Your machine language programs will invoke the various functions of the Graphics Tablet firmware by performing JSR (Jump to SubRoutine) operations to subroutines inside the Tablet's ROM, rather than using the PR# and IN# statements in BASIC. Your programs will pass information to the Tablet by storing it in fixed locations in memory, and will receive information from the Tablet by storing it in other fixed locations, instead of using PRINT and INPUT statements as a BASIC program would.

Since the Tablet firmware operates in the same manner regardless of whether it is being driven by a BASIC or a machine language program, this section will explain only the specifics of machine language operation of the Tablet. For a description of the modes and parameters which the Tablet firmware recognizes, please see the previous section.

The Tablet firmware is absolutely located in the Apple's memory at locations $C800 through $CFFF. This is a 2K memory space which is shared by all peripherals, and can be used by any one peripheral card at any time. In order to let the Graphics Tablet card take posession of this common ROM space, you must reference two special memory locations. First, you must reference location $CFFF. This will turn off all interface cards which may be using the common ROM space. Then you must make at least one reference to any address in the range $Cn00 through $CnFF, where n is the number (from 0 to 7) of the peripheral connector slot which holds the Graphics Tablet interface card. Once this is done, the Tablet's ROM will be placed into its proper memory range and you can reference its subroutines normally.

After you activate the ROM, you should store the slot number of the Graphics Tablet (in the format $Cn) in location $07F8. This lets other Apple programs know that the Tablet is active and in use.

Subroutine POINT (location $Cn02) lets you read a single point from the Tablet. The coordinates of the point, along with the pen status information, will be stored as a 15-character long ASCII string, beginning at location $0200 and ending with a RETURN code at location $020E. The format of this string is described in the previous section called ACCEPTING INPUT.

The subroutine DEFAULT (location $CE90) sets all the Graphics Tablet parameters and modes to their default values. It operates the same as the Tablet control command DEFAULT.

The subroutine MREAD (location $CBB9) allows you to read the pen position and status quickly, and get the result in binary (rather than ASCII, as POINT does). It returns the X and Y coordinates in the following locations:

XFFL	$0281	Lower byte of X-coordinate
XFFH	$0282	Upper byte of X-coordinate
YFFL	$0283	Lower byte of Y-coordinate
YFFH	$0284	Upper byte of Y-coordinate
TEM	$0280	Pen status

The X and Y coordinates are numbers from -32767 to +32767. Notice that this is a greater range than the coordinates passed by POINT. The numbers are in two's compliment form, and the high bit of the upper byte of each coordinate determines the sign of that coordinate. The pen status byte is interpreted much the same as it is for POINT: the lower 4 bits represent the pen status and the upper bit represents the keyboard status.

The SCALE subroutine (location $C870) is normally called immediately after MREAD. It performs a scaling and offset operation on the X and Y coordinates generated by MREAD and places the results in these four locations:

TEMXL	$0285	Lower byte of scaled X-coordinate
TEMXH	$0286	Upper byte of scaled X-coordinate
TEMYL	$0287	Lower byte of scaled Y-coordinate
TEMYH	$0288	Upper byte of scaled Y-coordinate

These values are also in two's compliment form and range from -32767 to +32767.

The CURSOROUT subroutine (location $C8F0) is normally called immediately after an MREAD. CURSOROUT calls SCALE and uses the scaled results to place a cursor on the Apple's screen. The cursor is placed by an exclusive-OR operation, so another call to CURSOROUT using the same coordinates will remove the cursor and leave the screen unchanged.

The CURSOROUT subroutine places the cursor on the screen which the Tablet was told to display. It is not necessarily the screen which the Apple is currently displaying. If you manually change the screen setting after calling DEFAULT or setting the Tablet PAGE parameter (see below), then the Apple may be displaying a video mode which is different from the one in which the Tablet is displaying a cursor.

You can pass parameters to the Tablet firmware by storing the proper values in special memory locations. Here are the locations used by the Tablet firmware.

The MSLOT parameter (location $07F8) contains the number of the slot (in the format $Cn) into which the Graphics Tablet Interface card is plugged.

The PAGE parameter (location $03B8+MSLOT) holds the code for the current video mode:

$20	high-resolution page 1	$40	high-resolution page 2
$01	low-resolution page 1	$02	low-resolution page 2
$21	Mixed high-resolution page 1	$42	Mixed high-resolution page 2
$05	Mixed low-resolution page 1	$0A	Mixed low-resolution page 2
$04	Text page 1	$08	Text page 2

$00 No cursor

If you set the high bit of the PAGE byte, then the scale and offset factors will be applied.

The MPAGE parameter (location $0438+MSLOT) holds some of the same information as the PAGE parameter. The lower six bits of MPAGE are derived from the lower six bits of PAGE exclusive-ORed with the constant $25. The upper two bits represent the A, B, P, and Q parameters:

Bit 7 ON:	Stream mode on	Bit 7 OFF:	Stream mode off
Bit 6 ON:	Offset after scale	Bit 6 OFF:	Offset before scale

The scale and offset parameters are stored in the following locations:

SCALL	$0488+MSLOT	Lower byte of scaling divisor
SCALH	$0538+MSLOT	Upper byte of scaling divisor
OFFXL	$0588+MSLOT	Lower byte of X-offset
OFFXH	$0638+MSLOT	Upper byte of X-offset
OFFYL	$0688+MSLOT	Lower byte of Y-offset
OFFYH	$0738+MSLOT	Upper byte of Y-offset

The scaling divisor is a binary integer from 0 to 32767. The offsets are two's compliment binary numbers from -32767 to +32767.

QUICK DRAW

The QUICK-DRAW program is a machine language subroutine which acts as an intermediary between the Tablet Firmware and an Applesoft program. Since an Applesoft program using HPLOT cannot draw on the High-Resolution screen fast enough to keep up with the movements of the pen across the Tablet, the QUICK-DRAW subroutine talks directly to the Tablet and plots the points on the high-resolution screen. QUICK-DRAW also makes the points plotted available to the Applesoft program.

QUICK-DRAW must run on an Apple with at least 16K bytes of memory, the Applesoft II BASIC programming language in ROM or the Language System, and a Graphics Tablet Interface card. The Graphics Tablet Firmware must be activated by an IN# command before QUICK-DRAW can be called.

The QUICK-DRAW subroutines are hidden inside an Applesoft program. When you RUN QUICK-DRAW, the Applesoft program will store the subroutines in the memory range $C00-$FFF (decimal 3072-4095). The entry point for the subroutines will be placed in memory locations $2F0 and $2F1 (decimal 752 and 753). Your Applesoft program, which you will RUN right after you RUN QUICK-DRAW, can PEEK at these locations and get the entry point by executing this line:

```
100 EP%=PEEK(752)+256*PEEK(753)
```

The QUICK-DRAW subroutine deals directly with four Applesoft variables. When you CALL the QUICK-DRAW subroutines, it takes the coordinates of the points it receives from the Tablet and places them in the two Applesoft arrays X% and Y%. It uses the Applesoft variable

N% as an index into these arrays. The subroutine also uses the contents of the variable D% as a DELTA value. It is the QUICK-DRAW subroutine which controls the DELTA and Audio Feedback features of the Tablet software.

You must dimension the arrays X% and Y% prior to calling QUICK-DRAW. Also, you must assign a non-zero value to D%. The D% value is used as described in the DELTA function in Chapter 2; if the value of D% is negative, then the Audio Feedback feaure will be turned off.

The QUICK-DRAW subroutine will return control to the Applesoft program under any of four conditions:

1) A key on the keyboard was pressed before the pen was pressed down.

2) The pen was moved to a place on the Tablet which does not correspond to a position in the current VIEWPORT.

3) The pen was lifted after being pressed down inside the VIEWPORT.

4) There is no more room in the arrays X% and Y% to store coordinate values.

When one of these conditions arises, the code for that termination condition will be stored in location $2BC (decimal 700) and control will be returned to the Applesoft program.

You can define a VIEWPORT for the QUICK-DRAW subroutines by storing:

- the coordinate of the left edge in locations 3089 and 3090;
- the coordinate of the right edge plus one in locations 3091 and 3092;
- the coordinate of the top edge in location 3093; and
- the coordinate of the bottom edge plus one in location 3094.

See lines 1100 and 1120 of the TABLET-CODE APPLESOFT program for an example of how to pass VIEWPORT coordinates to the QUICK-DRAW subroutine.

BY ANY OTHER NAME

You can change the names of the variables which QUICK-DRAW will use by executing a special CALL to QUICK-DRAW. Normally, QUICK-DRAW uses these variable names:

D% for the DELTA value
X% for the X-coordinate array
N% for the index to the arrays
Y% for the Y-coordinate array

You can change these four variable names to be whatever you like. However, they must always be of the integer variable type (denoted by the percent sign (%) following the name). To rename the variables, use this format:

```
220 CALL EP%,DELTA%,NUMBER%,XVAL%,YVAL%
```

Since Applesoft only recognizes the first two letters of a variable name, this will make QUICK-DRAW use the variable DE% for its DELTA, NU% for N%, XV% for X%, and YV% for Y%. If you want to change only one of the names, just leave the others out, but keep the proper number of commas:

```
230 CALL EP%,,IN%,,
```

will make QUICK-DRAW use the variable IN% instead of N%. You must keep the variable names in the order D%,N%,X%,Y%.

APPENDIX A
USE AND CARE

CARE OF THE MENU OVERLAY

You can write on the clear plastic menu overlay with most anything: soft (Number 2) pencils, felt-tip pens, permanent markers, crayons, and the like. However, ball-point pens tend not to write well on the overlay, and colored or hard lead pencils also have problems.

You can wipe the overlay clean of most marks or doodles you have drawn using a soft cloth and a mild soap-and-water solution. Most marks from felt-tip or "permanent" markers can be removed easily. Some markers, however, will leave truly permanent scars on the overlay; it's a good idea to test any marker on an inconspicuous corner of the overlay before you use it to draw all over your Tablet. To be safe, use felt-tip markers designed for use on acetate or mylar (or for use with overhead projectors). These will give you visible, non-smearing colors, but the marks will wipe off without a trace.

If you are getting inexplainable "glitches" on your screen you probably have a static problem. The solution is simple: Wipe the overlay with the static cloth that came with your Graphics Tablet. A treatment with the cloth should remove any excess static from the overlay.

CARE OF THE TABLET

Your Graphics Tablet is constructed of a solid wood base, protected below by a sheet metal baseplate and above by a molded, snap-on plastic cover. If the top cover gets dirty, it can be cleaned with a soft cloth and a mild soap-and-water solution. Don't use any abrasives or strong detergents on the surface or case of the Tablet: they may scratch or damage the plastic. If possible, keep the Tablet covered when you aren't using it.

DON'T leave anything which has a strong magnetic field on or near the Tablet. This will disrupt its natural magnetic orientation and make it malfunction. Keep your diskettes off the Tablet! Its magnetic field may alter or erase the information on them. Don't place disk drives, televisions, electric motors, magnets, or large, heavy metallic objects on top of the Tablet.

Keep the Tablet in a cool, dry place. Don't leave it in direct sunlight or in a car trunk or some other hot, stuffy place. Too much heat will warp its cover.

Be careful with the Tablet when you're moving it from place to place. Don't drop it or jar it. Even though it's pretty solid, it can be seriously damaged by a bad fall.

CARE OF THE INTERFACE

The Interface card is really the most delicate part of the Graphics Tablet. When inserting, removing, or transporting it, be very careful not to bend any of its pins or components. To be safe, always carry it in the box in which it was shipped, nestled in protective foam. Keep it away from strong electrical or magnetic fields, and don't even think of touching it if there's a lot of static electricity in the area.

If you've been inserting and removing the Interface card into the Apple a lot, then it's possible that the metal "fingers" have gotten dirty and are not making good contact with the Apple. In this case, the easiest way to clean the fingers is to just use an ordinary pencil eraser and rub all of the gunk off. If you want to be thorough, use cotton swabs and rubbing alcohol to clean the fingers on the card.

IF IT DOESN'T WORK

If you've exposed your Tablet to bad magnetic influences or it's been bumped and jarred a lot, it may develop "dead spots" on its surface, spots where the pen won't draw. These aren't permanent, they're just a loss of magnetic orientation in certain spots of the Tablet. Take the Tablet to your Apple service center. The service center should have the proper equipment to reorient your errant Tablet and make it work again.

APPENDIX B
BACKING UP YOUR DISKETTES

WITH TWO DISK DRIVES

If your Apple has two disk drives, you can easily make a copy of either GRAPHICS TABLET SOFTWARE diskette by using the diskette copying program on your Apple SYSTEM MASTER diskette. You will need three diskettes:

1) One of the GRAPHICS TABLET SOFTWARE diskettes, enclosed with your Tablet;

2) The SYSTEM MASTER diskette, enclosed with your Disk II; and

3) A blank, uninitialized diskette. If you like, you can use a preinitialized diskette, but all information on that diskette will be destroyed.

Boot your system using the SYSTEM MASTER diskette (see your DOS manual, or, if you have an Autostart ROM, see your Autostart ROM manual) and type

RUN COPY

After the disk drive stops whirring, place the GRAPHICS TABLET SOFTWARE backup diskette in one drive, and place the blank diskette in the other. The GRAPHICS TABLET SOFTWARE diskette will be the "Original", and the blank diskette will be the "Duplicate". Follow the instructions in the section on using the COPY program in your DOS manual.

Once you've copied the diskette, label the duplicate so you'll know what it is. Then put the original away in a safe place. If you ever lose or destroy the duplicate, then before you start to use the original, make another copy of it. It's also a good idea to periodically make duplicate copies of the diskettes which hold your pictures.

WITH ONE DISK DRIVE

If your Apple has only one disk drive, then you'll have to copy all the programs which comprise the GRAPHICS TABLET SOFTWARE package one by one, loading each program from the original diskette and saving it to the duplicate. It's a lengthy procedure, but well worth your trouble.

Boot your system using the GRAPHICS TABLET SOFTWARE diskette. Press [ESC] to get to the HELLO menu, select [Q] to QUIT, and press [RETURN]. Now remove the diskette and write-protect it by sticking a write-protect tab (a thin but sturdy strip of tape will do) over the

square notch on the left side of the diskette. This is important! It will prevent you from accidentally destroying anything on the original diskette. Now insert a blank, uninitialized diskette in the drive. You can use a preinitialized diskette, but all information on it will be destroyed. Type

```
INIT HELLO
```

and press RETURN. You're now initializing the diskette with the HELLO program from the GRAPHICS TABLET SOFTWARE diskette. This takes about a minute.

Now switch to the GRAPHICS TABLET SOFTWARE diskette and type
LOAD MENU ALIGNMENT

Now switch to the duplicate diskette and type
SAVE MENU ALIGNMENT

Now switch to the GRAPHICS TABLET SOFTWARE diskette and type
LOAD TABLET-CODE APPLESOFT

Now switch to the duplicate diskette and type
SAVE TABLET-CODE APPLESOFT

Now switch to the GRAPHICS TABLET SOFTWARE diskette and type
LOAD QUICK-DRAW

Now switch to the duplicate diskette and type
SAVE QUICK-DRAW

Now switch to the GRAPHICS TABLET SOFTWARE diskette and type
BLOAD UTILITIES
BLOAD GRAPHICS TABLET LOGO

Now switch to the duplicate diskette and type
BSAVE UTILITIES, A$6000, L$330
BSAVE GRAPHICS TABLET LOGO, A$2000, L$2000

Now enter this program:

```
NEW

10 D$=CHR$(4)
20 PRINT D$;"OPEN GRAPHICS TABLET SOFTWARE"
30 PRINT D$;"WRITE GRAPHICS TABLET SOFTWARE"
40 PRINT "RUN QUICK DRAW"
50 PRINT "RUN TABLET-CODE APPLESOFT"
60 PRINT D$;"CLOSE GRAPHICS TABLET SOFTWARE"
70 END
```

RUN

This short program creates an EXEC file called GRAPHICS TABLET SOFTWARE, whose function is to set up the Apple to RUN the programs which make the Graphics Tablet work. You need to have this file on every duplicate diskette you make; if you're going to be making many duplicate copies, you might want to SAVE this short program so you don't have to retype it every time you need it.

To SAVE this program, type

SAVE FILEMAKER

Then, whenever you're making a duplicate, put in this diskette and type

LOAD FILEMAKER

put in the duplicate diskette, and type

RUN

That's all there is. Once you've copied the diskette, label the duplicate so you'll know what it is and put it away in a safe place. If you ever lose or destroy the original, then before you start to use the duplicate, make another copy of it.

APPENDIX C
COLOR ANOMALIES

UNUSUAL COLOR EFFECTS...

You may have already noticed that a few strange things happen when you try to use certain combinations of colors with the Graphics Tablet. Don't worry: these are normal, predictible phenomena which are caused not by the Tablet, but by the Apple itself.

The Graphics Tablet displays its pictures using the Apple's high-resolution graphics mode. In this mode, there are 53,760 individual dots on the screen, and six colors (black, white, orange, blue, green, and violet). The Apple should therefore need several hundred thousand individual "bits" of information to form a picture. But the Apple uses only 65,536 bits of information (organized into 8,192 eight-bit "bytes") to form the picture! The reason the Apple can display such complex pictures using so little memory is the same reason that sometimes the colors don't appear normal: not all colors can be used in all places on the screen, and each dot is limited in the number of colors it can be.

This specialization of function causes some combinations of colors to work differently than you might expect. There are three different effects which are caused by the limitation in the color scheme. They occur in all drawing modes, but only where one color borders another and the borderline is not horizontal. For example, the color problems could occur on the two vertical sides of a FRAME but not on the top or bottom. Here are the three effects:

1) DASHED LINES. When you draw black or white lines on a colored field (or vice versa), non-horizontal lines will tend to become dashed and incomplete, and vertical lines may not appear at all.

2) ZEBRA STRIPES. When you draw colored lines on a colored field, non-horizontal lines don't appear their normal colors, but instead are sometimes black-and-white striped. Vertical lines will appear either completely black or completely white.

3) COLOR FLIP. When you draw with one color (or black or white) across a colored field, sometimes a seven-dot wide area around a non-horizontal line will change color. This will result in a colored "shadow" appearing around the line.

These effects occur in various combinations, depending upon the colors you use.

. . . AND HOW TO GET THEM

The table on the next page illustrates seven different combinations of the effects mentioned above, and what color combinations produce which effects. To use the table, find the pen color you're using along the left side of the table. Then look on the top edge of the table and find the color of the area on the screen across which you want to draw. Where the row for the pen color and the column for the field color intersect, there's a number. Find the number in the legend to the table and read about the effect you'll get.

About BLACK1, WHITE1, BLACK2, and WHITE2: Due to the vagaries of the Apple's color generation scheme, there are two instances each of the colors black and white. When you look at the Tablet color menu (see the section on PEN COLOR in Chapter 2), you'll see that there are two black squares and two white squares along with the four colored squares. The black and white in the top row are BLACK1 and WHITE1; the ones in the bottom row are BLACK2 and WHITE2. The reason for the duplication is that the 1's cause fewer problems when used with green and violet than do the 2's, and similarly the 2's go better with blue and orange than do the 1's. When this book refers to black or white, it means BLACK1 or WHITE1.

PEN COLOR

FIELD COLOR	BLACK1	GREEN	VIOLET	WHITE1	BLACK2	ORANGE	BLUE	WHITE2
BLACK1	0	2	2	1	0	2	2	1
GREEN	2	0	3	2	4	5	6	4
VIOLET	2	3	0	2	4	6	5	4
WHITE1	1	2	2	0	1	2	2	0
BLACK2	0	2	2	1	0	2	2	1
ORANGE	4	5	6	4	0	0	3	2
BLUE	4	6	5	4	2	3	0	2
WHITE2	1	2	2	0	1	2	2	0

Color Effects Table

LEGEND:

0: No effect.

1: Colors appear as expected; no anomalies.

2: DASHED LINES on non-horizontal lines; vertical lines may disappear.

3: ZEBRA STRIPING on non-horizontal lines; vertical lines appear solid black or white.

4: DASHED LINES with a COLOR FLIP.

5: Pure COLOR FLIP: non-horizontal lines appear "chunky" and wider than normal.

6: ZEBRA STRIPING with a COLOR FLIP.

APPENDIX D
PROGRAM LISTINGS

TABLET-CODE APPLESOFT

```
10  REM  * TABLET SOFTWARE. COPYRIGHT APPLE 1979. B  EHLERS *
20  LOMEM: 25392
30 D$ = CHR$ (4)  PRINT D$;"CLOSE GRAPHICS TABLET SOFTWARE"
40  ONERR  GOTO 2610
50 D$ = CHR$ (4): PRINT D$;"OPEN TAB.INFORMATION.D1": PRINT D$;"READ TAB
    .INFORMATION": INPUT SL: INPUT XL: INPUT YL: INPUT XH: INPUT YH
60  PRINT   PRINT D$;"CLOSE TAB.INFORMATION"
70  ONERR  GOTO 2650
80 FP% =  PEEK (753) * 256 +  PEEK (752): M% = 800
90  DIM Y%(M%), X%(M%)
100  PRINT D$;"BLOAD UTILITIES.A$6000.D1"
110 XA = XH - XL: YA = YH - YL: LT =  INT ((XA + YA) / 2): PI =  INT (LT / 11
    )
120 S0 =  INT (XA / 11 +  5)
130 MD =  INT (PI / 2): XM = XL: YM = 2 * MD + YL
140  HGR2 : PC = 3: BC = 0:  HCOLOR= PC: W = 1: DF = 1
150 X1 = XM + 2: Y1 = YM + 2: X2 = ( INT ((XH + 2 - X1) / 280 +  5) + 280): Y
    2 =  INT (X2 * 192 / 280): X3 = X1: X4 = X2: Y3 = Y1: Y4 = Y2
160 D% =  - 2: SM = 52:  GOSUB 1070: RD = 0
170 CM = 0: N% = 1:  CALL FP%: CD =  PEEK (700):  ON CD + 1 GOTO 190,200,170,1
    70
180  GOTO 170
190  PRINT   PRINT D$;"PR#0": PRINT D$;"IN#0": GET A$:  IF  ASC (A$) <  > 2
    7 THEN 200
192  TEXT   HOME : VTAB 12: HTAB 13: INPUT "QUIT? (Y OR N) ";A$:  IF A$ = "
    Y" THEN  HOME : VTAB 12: HTAB 10: PRINT "LOADING HELLO PROGRAM": POKE
    104,8  POKE 103,1:  PRINT D$;"RUN HELLO.D1":  STOP
194  GOSUB 1130:  GOTO 170
200  IF  PEEK (640) <  > 2 THEN 170
210  POKE 640,0
220 XF = XL * 2: YF = YL * 2: SF = S0:  GOSUB 2590:  REM    SENSE
    MENU
230  PRINT : PRINT D$;"IN#";SL
240  INPUT X,Y,Z:  IF Y > 1 THEN  GOSUB 1130:  GOTO 170
250  IF Y <  = 1 AND Y >  = 0 THEN  PRINT D$;"PR#0": PRINT  CHR$ (7): PRINT
    : PRINT D$;"PR#";SL:  PRINT "N":  ON Y + 1 GOTO 280,290
260  GOTO 230
270  TEXT   PR# 0  PRINT "ERROR":  STOP
280  ON X + 1 GOTO 140,300,690,620,1460,550,1150,2160,1360,650,290,1560,16
    80,1740,1340,570,330,420,2490,2330,1970,2070
290  GOSUB 1130  GOTO 170
300  IF XT = X3 AND YT = Y3 AND X4 = XB AND Y4 = YB THEN  HCOLOR= BC  HPLOT
    0,0  CALL 62454:  GOTO 520
310  HCOLOR= BC  HPLOT X3,Y3:  FOR T1 = Y3 TO Y4:  HPLOT X3,T1 TO X4,T1  NEXT
      HCOLOR= PC  GOSUB 1130:  GOTO 170
330  TEXT   PRINT D$;"PR#0":  HOME  VTAB 7: HTAB 6:  PRINT "PLEASE TYPE THE
     PICTURE NAME."  PRINT   HTAB 7:  PRINT D$;"IN#0":  INPUT "==> ";B$:  IF
    B$ = "" THEN  GOSUB 1130  GOTO 170
340  VTAB 9: HTAB 37  CALL  - 662:  HTAB 1:  GOSUB 530
345 B$ = "PIC." + B$  ONERR  GOTO 400
350  PRINT D$;"BLOAD ";D$;",A$4000,V0,D";C$
360 S2 =  PEEK (16632) * 256 +  PEEK (16633):  IF S2 <  > 0 THEN 150
370 X1 =  PEEK (16504) * 256 +  PEEK (16505): X2 =  PEEK (16506) * 256 +  PEEK
    (16507): Y1 =  PEEK (16508) * 256 +  PEEK (16509): Y2 =  PEEK (16510) *
    256 +  PEEK (16511)
380  ONERR  GOTO 2650
390  HOME   GOTO 520
400 B$ =  RIGHT$ (B$,( LEN (B$) - 4)):  ONERR  GOTO 2650
410  PRINT D$;"BLOAD ";B$;",A$4000,V0,D";C$:  GOTO 150
420  TEXT : PRINT D$;"PR#0":  HOME   VTAB 7:  HTAB 3:  PRINT "PLEASE TYPE A N
    AME FOR THIS PICTURE.":  PRINT   HTAB 7:  PRINT D$;"IN#0":  INPUT "==> "
    ;B$:  IF B$ = "" THEN  GOSUB 1130:  GOTO 170
430  VTAB 9: HTAB 37:  CALL  - 868:  HTAB 1:  GOSUB 530
440  GOSUB 1330:  HCOLOR= BC:  GOSUB 1040: H =  INT (X1 / 256):  POKE 16504,H
     POKE 16505,X1 - H * 256: H =  INT (X2 / 256):  POKE 16506,H:  POKE 1650
    7,X2 - H * 256: H =  INT (Y1 / 256)  POKE 16508,H:  POKE 16509,Y1 - H *
    256
450 H =  INT (Y2 / 256):  POKE 16510,H  POKE 16511,Y2 - H * 256: H =  INT (S
    2 / 256):  POKE 16632,H:  POKE 16633,S2 - H * 256
```

```
460 B$ = "PIC " + B$: ONERR  GOTO 490
470  HCOLOR= PC:  PRINT D$;"VERIFY ";B$;",D";C$:  ONERR  GOTO 2650
480  VTAB 21:  HTAB 1:  PRINT "A PICTURE ALREADY EXISTS WITH THAT NAME ":  PRINT
      HTAB 12:  INPUT "CONTINUE (Y OR N) ";E$:  IF E$ <  > "Y" THEN 510
490  ONERR  GOTO 2650
500  PRINT D$;"BSAVE ";B$;",A$4000,L$1FF8,V0,D";C$
510  HOME :  PRINT D$;"PR#";SL:  PRINT "H2,N"
520  GOSUB 1090:  PRINT D$;"IN#";SL:  GOTO 170
530  VTAB 10:  CALL  - 958:  PRINT :  HTAB 16:  PRINT "DRIVE # >    (DEFAULT="
     ;DF;")";  HTAB 25:  INPUT " ";C$:  IF C$ <  > "1" AND C$ <  > "2" THEN
     C$ =  STR$ (DF)
540 DF =  VAL (C$):  VTAB 11:  HTAB 24:  CALL  - 958:  PRINT C$:  RETURN
550  REM  *** SOFT RESET COMMAND ***
560  GOSUB 1330:  GOSUB 1090:D% =  - 2:  GOTO 170
570  TEXT :  PRINT D$;"PR#0":  HOME :  PRINT D$;"IN#0":  GOSUB 530
580  HOME :  HTAB 7:  PRINT "PRESS SPACE BAR TO CONTINUE.":  POKE 34,2
590  PRINT D$;"CATALOG  D";C$
600  POKE  - 16368,0:  GET A$:  IF A$ <  > " " THEN 600
610  GOSUB 1130:  GOTO 170
620  REM  *** BACKGROUND AND PEN COLOR ***
630 T1 = PC:  GOSUB 670:  IF PC = 8 THEN PC = T1:  GOSUB 1130:  GOTO 660
640 BC = PC:PC = T1:  HCOLOR= BC:  HPLOT 0,0:  CALL 62454:  GOTO 520
650 T3 = PC:  GOSUB 670:  GOSUB 1130:  IF PC = 8 THEN PC = T3
660  ON CM + 1 GOTO 170,1580,1660,1740,1840
670 XF = XM + 2:YF = YM + 2:SF =  INT ((XH - XM) / 140)
680  PRINT D$;"PR#0":  TEXT :  HOME :  PRINT D$;"PR#";SL:  PRINT "G1,R,X";XF,"
     ,Y";YF;",S";SF,  GR :  HOME :  VTAB 22:  HTAB 9:  PRINT "CONSTRUCTING COLO
     R MENU "
690  COLOR= 5:  FOR ZZ = 0 TO 39:  HLIN 0,39 AT ZZ:  NEXT
700 X8 = 9 Y8 = 17:X9 = 2:Y9 = 2:C9 = 0:  GOSUB 880:X9 = 11:Y9 = 2:C9 = 12:
      GOSUB 880:X9 = 20:Y9 = 2:C9 = 3:  GOSUB 880:X9 = 29 Y9 = 2 C9 = 15:  GOSUB
     880
710 X9 = 2:Y9 = 21:C9 = 0  GOSUB 880:X9 = 11:Y9 = 21:C9 = 9:  GOSUB 880 X9 =
     20 Y9 = 21:C9 = 6:  GOSUB 880:X9 = 29:Y9 = 21:C9 = 15:  GOSUB 880
720  HOME :  VTAB 22:  HTAB 7:  PRINT "USE THE PEN TO PICK A COLOR.":  PRINT
      PRINT D$;"PR#";SL:  PRINT "N"
730  PRINT D$;"IN#";SL:  INPUT X,Y,Z:  IF Z < 0 THEN  PRINT D$;"IN#0"  GET A
     $:X = 0:Y = 0:  PRINT :  IF  ASC (A$) = 13 THEN PC = 8:  RETURN
740  IF Z <  > 2 THEN 730
750 X =  INT (X / 7):Y =  INT (Y / 4)
760  IF Y < 2 OR Y > 37 OR Y = 19 OR Y = 20 OR X < 2 OR X > 37 THEN 730
770  PRINT D$;"PR#0":  PRINT  CHR$ (7):  IF Y > 1 AND Y < 19 THEN  ON  INT (
     (X - 2) / 9) + 1 GOTO 790,800,810,820
780  ON  INT ((X - 2) / 9) + 1 GOTO 830,840,850,860
790 PC = 0:B$ = "BLACK1":  GOTO 870
800 PC = 1:B$ = "GREEN":  GOTO 870
810 PC = 2:B$ = "VIOLET":  GOTO 870
820 PC = 3:B$ = "WHITE1":  GOTO 870
830 PC = 4:B$ = "BLACK2":  GOTO 870
840 PC = 5:B$ = "ORANGE":  GOTO 870
850 PC = 6:B$ = "BLUE":  GOTO 870
860 PC = 7:B$ = "WHITE2"
870  HOME :  VTAB 22:  HTAB (40 -  LEN (B$)) / 2:  PRINT B$:  FOR ZZ = 1 TO 50
     0:  NEXT  HCOLOR= PC:  HOME  RETURN
880  COLOR= C9:  FOR ZZ = 1 TO X8:  VLIN Y9,Y9 + Y8 - 1 AT X9:X9 = X9 + 1:  NEXT
     :  RETURN  REM  COLOR BOX LO-RES DRAW
890  REM  *** WINDOW COMMAND ***
900  PRINT  PRINT D$;"PR#";SL:  PRINT "T1,F,C":  PRINT D$;"PR#0"
910  TEXT :  HOME :  VTAB 9:  HTAB 15:  PRINT "PRESS PEN AT":  PRINT :  HTAB 8:  INVERSE
920  PRINT D$;"PR#";SL:  PRINT "N,C":  PRINT D$;"IN#";SL:  INPUT X,Y,Z:  IF Z <
     0 THEN  PRINT D$;"IN#0":  GET A$:  IF  ASC (A$) = 68 THEN  GOSUB 1330:  HCOLOR=
930  IF Z < 0 THEN  IF  ASC (A$) = 13 THEN  GOSUB 1130  GOTO 170
940  IF Z <  > 2 THEN 920
950  PRINT D$;"PR#0":  IF X < XM + 2 OR Y < YM + 2 THEN  VTAB 22:  HTAB 4  PRINT
      CHR$ (7);"PLEASE STAY WITHIN THE WORK-AREA.":  FOR ZZ = 1 TO 500:  NEXT
     ZZ:  VTAB 22:  CALL  - 868:  GOTO 920
960  VTAB 11:  CALL  - 868:  HTAB 8:  PRINT "UPPER-LEFT AND ";  INVERSE :  PRINT
     "LOWER-RIGHT":  NORMAL
970  PRINT D$;"PR#";SL:  PRINT "N,C":  INPUT TX,TY,Z:  IF Z < 0 THEN  PRINT D
     $;"IN#0":  GET A$:  IF  ASC (A$) = 68 THEN  GOSUB 1330:  HCOLOR= BC:  GOSUB
     1040:X1 = X5:X2 = X6:Y1 = Y5:Y2 = Y6:  GOSUB 1070:  GOTO 170
980  IF Z < 0 THEN  IF  ASC (A$) = 13 THEN  GOSUB 1130:  GOTO 170
990  IF Z <  > 2 THEN 970
```

```
1000  PRINT   PRINT D$;"PR#0": IF TX > XH + 2 OR TY > YH + 2 THEN  VTAB 22
      HTAB 4  PRINT  CHR$ (7);"PLEASE STAY WITHIN THE WORK AREA.": FOR ZZ
      = 1 TO 500: NEXT ZZ: VTAB 22: CALL  - 868: GOTO 970
1010  IF TX < X OR TY < Y THEN  VTAB 22: HTAB 5: PRINT  CHR$ (7);"PLEASE S
      PECIFY POINTS CORRECTLY!": FOR ZZ = 1 TO 500: NEXT ZZ: GOTO 910
1020 X1 = X: X2 = TX - X1 + 1: Y1 = Y: Y2 = TY - Y1 + 1
1030  GOSUB 1330: HCOLOR= BC: GOSUB 1040: GOSUB 1070: GOTO 170
1040 XT =  INT (GF): XB = 279 - XT: YT =  INT (HF): YB = 191 - YT  IF XT >  =
     2 THEN  HPLOT XT - 1, YT TO XT - 1, YB: HPLOT XT - 2, YT TO XT - 2, YB: HPLOT
     XB + 1, YT TO XB + 1, YB: HPLOT XB + 2, YT TO XB + 2, YB
1050  IF YT >  = 1 THEN  HPLOT XT, YT - 1 TO XB, YT - 1: HPLOT XT, YB + 1 TO
     XB, YB + 1
1060  RETURN
1070 T1 = X2 / 280: T2 = Y2 / 192: IF T1 < T2 THEN S2 = T2: IF  INT (T2) <
     T2 THEN S2 =  INT (T2) + 1
1080  IF T1 >  = T2 THEN S2 = T1. IF  INT (T1) < T1 THEN S2 =  INT (T1) +
     1
1090 RD = 0: GOSUB 1130: HCOLOR= 0: IF BC = 0 OR BC = 4 THEN  HCOLOR= 3
1100  GOSUB 1040: HCOLOR= PC: B1 =  INT (XT / 256): B2 = XT - B1 * 256: B3 =
      INT ((XB + 1) / 256): B4 = (XB + 1) - B3 * 256: B5 = YT: B6 = YB + 1: X3
      =  INT (XT): X4 =  INT (XB): Y3 =  INT (YT): Y4 =  INT (YB)
1110  GOSUB 1330: HCOLOR= PC: WM = 1: W$ = "": ONERR  GOTO 2650
1120 BX = 3089: POKE BX, B2: POKE BX + 1, B1: POKE BX + 2, B4: POKE BX + 3, B3
     : POKE BX + 4, B5: POKE BX + 5, B6: RETURN
1130  IF RD > 0 THEN  GOSUB 1400: RETURN
1140 GF = (280 - X2 / S2) / 2: HF = (192 - Y2 / S2) / 2: XF =  INT (X1 - GF *
     S2): YF =  INT (Y1 - HF * S2): SF = S2: GOSUB 2590: RETURN
1150  REM  *** VIEWPORT COMMAND ***
1160  HCOLOR= 3: IF BC = 3 OR BC = 7 THEN  HCOLOR= 0
1170  GOSUB 1330: XF =  INT (X1 - GF * S2): YF =  INT (Y1 - HF * S2): SF = S2
      GOSUB 2590
1180  GOSUB 1290: GOSUB 1310
1190  IF Z < 0 THEN  PRINT D$;"IN#0": PRINT : GET A$: IF  ASC (A$) = 13 THEN
      GOSUB 1130: GOSUB 1330: HCOLOR= PC: GOTO 170
1200  IF Z < 0 THEN  IF  ASC (A$) = 68 THEN  GOSUB 1090: GOTO 170
1205  IF Z < 0 THEN  GOTO 1160
1210  IF XT > X OR XB < X OR YT > Y OR YB < Y THEN 1180
1220 T1 = X - 1: T2 = Y - 1: H = 0: XB = T1: YB = T2: GOSUB 1350
1230  GOSUB 1280: GOSUB 1310: IF Z < 0 THEN  GOSUB 1390: GOTO 1190
1240  IF XT > X OR XB < X OR YT > Y OR YB < Y THEN 1230
1250  IF X < T1 OR Y < T2 THEN  GOSUB 1350: PRINT D$;"PR#0": TEXT : HOME :
      VTAB 12: HTAB 5: PRINT "PLEASE SPECIFY POINTS CORRECTLY": GOSUB 1300
      GOSUB 1140: GOTO 1180
1260 WM = 1: W$ = "": GOSUB 2590: RD = 0
1270 X3 = T1 + 1: Y3 = T2 + 1: X4 = X: Y4 = Y: H = 0: GOSUB 1350: GOSUB 1330: B
     1 =  INT (X3 / 256): B2 = X3 - B1 * 256: B3 =  INT ((X4 + 1) / 256): B4 =
     (X4 + 1) - B3 * 256: B5 = Y3: B6 = Y4 + 1: GOSUB 1120: HCOLOR= PC: GOTO
     170
1280  PRINT   PRINT D$;"PR#0": GOSUB 2300: PRINT D$;"PR#";SL: PRINT "M2": VTAB
     23: HTAB 15: POKE 41, PEEK (41) + 4: PRINT  CHR$ (7);"LOWER-RIGHT?": FOR
     T3 = 1 TO 500: NEXT   PRINT D$;"PR#";SL: PRINT "N,M2": RETURN
1290  PRINT   PRINT D$;"PR#0": GOSUB 2300: PRINT D$;"PR#";SL: PRINT "M2": VTAB
     23: HTAB 15: POKE 41, PEEK (41) + 4: PRINT  CHR$ (7);"UPPER-LEFT?": FOR
     T3 = 1 TO 500: NEXT   PRINT D$;"PR#";SL: PRINT "N,M2": RETURN
1300  FOR H = 1 TO 1000: NEXT H: RETURN
1310  PRINT D$;"IN#";SL: INPUT " ";X,Y,Z: IF Z = 2 OR Z < 0 THEN  RETURN
1320  GOTO 1310
1330  POKE 233,99: POKE 232,32: HCOLOR= 0: IF BC = 0 OR BC = 4 THEN  HCOLOR=
     3
1340 H = 0: XB = X3 - 1: YB = Y3 - 1: GOSUB 1350: H = 16: XB = X4 + 1: YB = Y3 -
     1: GOSUB 1350: H = 32: XB = X4 + 1: YB = Y4 + 1: GOSUB 1350: H = 48: XB =
     X3 - 1: YB = Y4 + 1: GOSUB 1350: RETURN
1350  IF XB >  = 0 AND XB < 280 AND YB >  = 0 AND YB < 192 THEN  ROT= H: SCALE=
     1: XDRAW 1 AT XB, YB
1360  RETURN
1380 RD = RD + 1: IF RD > 1 THEN RD = 0: GOSUB 1130: ON CM + 1 GOTO 170, 15
     80, 1680, 1740, 1840
1390  GOSUB 1400: ON CM + 1 GOTO 170, 1580, 1680, 1740, 1840
1400  IF X4 = X3 OR Y4 = Y3 THEN 1440
1410 T1 = ((XM * 2) - (XM * 2)) / (X4 - X3): T2 = ((YM * 2) - (YM * 2)) / (
     Y4 - Y3): SF =  INT (T1): IF T2 < T1 THEN SF =  INT (T2)
1420 XF =  INT ((XM * 2) - (SF * X3)): YF =  INT ((YM * 2) - (SF * Y3)): IF
      ABS (XF) > 27000 OR  ABS (YF) > 27000 THEN  GOTO 1440
```

```
1430  GOSUB 2590: RETURN
1440  PRINT D$;"PR#0": GOSUB 2300: PRINT : PRINT D$;"PR#";SL: PRINT "M2,C"
      : VTAB 23: HTAB 14: POKE 41, PEEK (41) + 4: PRINT "NOT POSSIBLE.": RD =
     0: GOSUB 1300: GOSUB 1130: RETURN
1460  PRINT : PRINT D$;"PR#";SL: PRINT "T1,C": PRINT D$;"PR#0" PRINT D$;"
     IN#0": TEXT
1470  HOME : PRINT : HTAB 9: PRINT "FAST-DRAW DELTA SETTING": VTAB 5: HTAB
     7: PRINT "CURRENT DELTA SETTING IS "; ABS (D%);" ": PRINT :A$ = "ON."
     : IF D% < 0 THEN A$ = "OFF."
1480  HTAB 10: PRINT "AUDIO FEEDBACK IS ";A$
1490  VTAB 18: CALL  - 958: HTAB 11: INPUT "NEW DELTA EQUALS ";A$: IF A$ =
     "" THEN 1530
1500  IF  VAL (A$) < 1 OR  VAL (A$) > 127 THEN 1490
1510  IF D% < 1 THEN D% =  -  VAL (A$): GOTO 1530
1520 D% =  VAL (A$)
1530  VTAB 20: CALL  - 958: HTAB 9: INPUT "TURN AUDIO FEEDBACK ";A$: IF A$
      = "" THEN 1560
1540  IF  LEFT$ (A$,2) <  > "ON" AND  LEFT$ (A$,3) <  > "OFF" THEN 1530
1550 D% =  ABS (D%): IF  LEFT$ (A$,3) = "OFF" THEN D% =  - D%
1560  GOSUB 1130: GOTO 170
1580  GOSUB 1130: PRINT D$;"IN#";SL:CM = 1
1590 RT = 2: INPUT X,Y,Z: IF Z <  > 2 THEN  POKE  - 16368,0: GOTO 1590
1600  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940  IF RT = 1 THEN
     220
1610  IF RT = 0 THEN 1590
1620  HPLOT X,Y
1630 RT = 2: INPUT X,Y,Z: IF Z <  > 2 THEN  POKE  - 16368,0: GOTO 1630
1640  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940: IF RT = 1 THEN
     220
1650  IF RT = 0 THEN 1630
1660  HPLOT  TO X,Y: GOTO 1630
1680  GOSUB 1130: PRINT D$;"IN#";SL:CM = 2
1690 RT = 2: INPUT X,Y,Z: IF Z <  > 2 THEN  POKE  - 16368,0: GOTO 1690
1700  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940: IF RT = 1 THEN
     220
1710  IF RT = 0 THEN 1690
1720  HPLOT X,Y: GOTO 1690
1740  GOSUB 1130: PRINT D$;"IN#";SL:CM = 3
1750 RT = 2: INPUT X,Y,Z: IF Z <  > 2 THEN  POKE  - 16368,0: GOTO 1750
1760  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940: IF RT = 1 THEN
     220
1770  IF RT = 0 THEN 1750
1780  HPLOT X,Y:TX = X TY = Y
1790 RT = 2: INPUT X,Y,Z: IF Z <  > 2 THEN  POKE  - 16368,0  GOTO 1790
1800  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940  IF RT = 1 THEN
     220
1810  IF RT = 0 THEN 1790
1820  HPLOT X,Y TO TX,Y TO TX,TY TO X,TY TO X,Y: GOTO 1750
1840  GOSUB 1130  PRINT D$;"IN#";SL CM = 4
1850 RT = 2: INPUT X,Y,Z  IF Z <  > 2 THEN  POKE  - 16368,0: GOTO 1850
1860  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940: IF RT = 1 THEN
     220
1870  IF RT = 0 THEN 1850
1880  HPLOT X,Y TX = X TY = Y
1890 RT = 2  INPUT X,Y,Z: IF Z <  > 2 THEN  POKE  - 16368,0: GOTO 1890
1900  IF X < X3 OR X > X4 OR Y < Y3 OR Y > Y4 THEN  GOSUB 1940: IF RT = 1 THEN
     220
1910  IF RT = 0 THEN 1890
1920  IF Y < TY THEN  FOR H = Y TO TY: HPLOT X,H TO TX,H: NEXT : GOTO 1850

1930  FOR H = TY TO Y: HPLOT X,H TO TX,H: NEXT : GOTO 1850
1940  IF (Y + SF + YF - YL * 2) / SO < 2 THEN RT = 1: RETURN
1950  PRINT D$;"PR#0": GOSUB 2300: PRINT D$;"PR#";SL  PRINT "M2": VTAB 23:
      HTAB 3  POKE 41, PEEK (41) + 4: PRINT "POINT OUTSIDE VIEWPORT.  RESP
     ECIFY "  GOSUB 1300: PRINT D$;"PR#";SL: PRINT "N,M2": RT = 0: RETURN
1970  GOSUB 1130:N% = 1: CALL EP% CD =  PEEK (7C0)  ON CD + 1 GOTO 190,197
     5,1980,1980
1975  IF N% = 1 THEN 1970
1980  HPLOT XX(1),YX(1) TO XX(N% - 1),YX(N% - 1): GOSUB 1990: GOSUB 1130  GOTO
     170
1990  PRINT D$;"PR#0": GOSUB 2300: PRINT D$;"PR#";SL: PRINT "M2": VTAB 23:
      HTAB 14: POKE 41, PEEK (41) + 4: PRINT  CHR$ (7);"CALCULATING.  ": IF
     N% = 2 THEN AR = 0: GOTO 2020
```

```
2000 AR = 0  FOR T1 = 2 TO N% - 1 DX = XX(T1) - XX(T1 - 1) DY = (YY(T1) +
     YY(T1 - 1)) / 2.AR = AR + DX * DY  NEXT T1
2010 AR = AR + ((XX(1) - XX(N% - 1)) * ((YY(1) + YY(N% - 1)) / 2) AR =  ABS
     (AR) / WM ^ 2  IF AR < 999999999 THEN AR = ( INT (AR * 100)) / 100
2020  GOSUB 2300  VTAB 23 B$ = "AREA IS "  POKE 41, PEEK (41) + 4  GOSUB 2
     030  GOSUB 1300  GOSUB 1300  RETURN
2030 B$ = B$ +  STR$ (AR) + " SQUARE " + W$ + " ": HTAB 21 -  INT ( LEN (B
     $) / 2)  PRINT B$. RETURN
2040  GOSUB 1130 N% = 1  CALL EP%.CD =  PEEK (700): ON CD + 1 GOTO 190, 207
     5, 2080, 2060
2075  IF N% = 1 THEN 2070
2080  GOSUB 2090  GOSUB 1130  GOTO 170
2090  PRINT D$;"PR#0"  GOSUB 2300  PRINT D$;"PR#";SL  PRINT "M2"  VTAB 23
      HTAB 14  POKE 41, PEEK (41) + 4  PRINT  CHR$ (7);"CALCULATING..."  IF
     N% = 2 THEN DT = 0  GOTO 2110
2100 DT = 0  FOR T1 = 2 TO N% - 1 DX = XX(T1) - XX(T1 + 1) DY = YY(T1) - Y
     Y(T1 - 1) DT = DT +  SQR (DX * DX + DY * DY)  NEXT  DT = DT / WM  IF
     DT < 999999999 THEN DT = ( INT (DT * 100)) / 100
2110  GOSUB 2300  VTAB 23 B$ = "THE DISTANCE IS ":  POKE 41, PEEK (41) + 4
      GOSUB 2120  GOSUB 1300  GOSUB 1300  RETURN
2120 B$ = B$ +  STR$ (DT) + " " + W$ + " ": HTAB 21 -  INT ( LEN (B$) / 2)
      PRINT B$. RETURN
2160  GOSUB 1130
2170  GOSUB 2310
2180  PRINT D$;"IN#";SL  INPUT X, Y, Z  IF Z < 0 THEN  PRINT D$;"IN#0"  GET
     A$  IF  ASC (A$) = 13 THEN  GOSUB 1130  GOTO 170
2190  IF Z <  > 2 THEN  PRINT  : GOTO 2180
2200  IF X3 > X OR X4 < X OR Y3 > Y OR Y4 < Y THEN 2170
2210  GOSUB 2320
2220  PRINT D$;"IN#";SL  INPUT TX, TY, Z  IF Z < 0 THEN  PRINT D$;"IN#0"  GET
     A$  IF  ASC (A$) = 13 THEN  GOSUB 1130  GOTO 170
2230  IF Z <  > 2 THEN  PRINT  GOTO 2220
2240  IF TX < X3 OR TX > X4 OR TY < Y3 OR TY > Y4 THEN 2210
2250  PRINT D$;"PR#";SL  PRINT "T1,C"  TEXT  HOME  T1 = TX - X + 1 T2 = T
     Y - Y + 1 DX =  SQR (T1 * T1 + T2 * T2)  VTAB 10  HTAB 6  PRINT "DIST
     ANCE IS ", INT (DX);" SCREEN UNITS "  PRINT D$;"IN#0"
2260  VTAB 18  CALL  - 958  HTAB 8  INPUT "YOUR NUMBER OF UNITS -> ";A$  IF
     A$ = "" THEN W = DX  GOTO 2280
2265  IF  VAL (A$) > 999999999 THEN 2260
2270 W =  VAL (A$)  IF W = 0 THEN 2260
2280  VTAB 20  CALL  - 958  HTAB 8  INPUT "TYPE OF UNITS -> ", W$  IF  LEN
     (W$) > 10 THEN 2280
2290 WM = DX / W  GOSUB 1130  GOTO 170
2300  FOR T4 = 21 TO 24  VTAB T4  HTAB 1  POKE 41, PEEK (41) + 4  PRINT "
                                          ",  NEXT T4  PRINT  RETURN
2310  PRINT D$;"PR#0"  GOSUB 2300  PRINT D$;"PR#";SL  PRINT "M2"  VTAB 23
      HTAB 13  POKE 41, PEEK (41) + 4  PRINT  CHR$ (7);"BEGINNING POINT?"
      FOR T3 = 1 TO 500  NEXT  PRINT D$;"PR#";SL  PRINT "N,M2"  RETURN
2320  PRINT D$;"PR#0"  GOSUB 2300  PRINT D$;"PR#";SL  PRINT "M2"  VTAB 22
      HTAB 14  POKE 41, PEEK (41) + 4  PRINT  CHR$ (7);"ENDING POINT?"  FOR
     T3 = 1 TO 500  NEXT  PRINT D$;"PR#";SL  PRINT "N,M2"  RETURN
2330  REM  *** CHRIS' SLIDE ***
2340  GOSUB 1130  HCOLOR= BC  GOSUB 1040
2350  GOSUB 1130  GOSUB 2310
2360  PRINT D$;"IN#";SL  INPUT X, Y, Z  IF Z < 0 THEN  PRINT D$;"IN#0"  GET
     A$  IF  ASC (A$) = 13 THEN 2470
2370  IF Z <  > 2 THEN  PRINT  GOTO 2360
2380  IF X < 0 OR X > 279 OR Y < 0 OR Y > 191 THEN 2350
2390  GOSUB 2320
2400  PRINT D$;"IN#";SL  INPUT TX, TY, Z  IF Z < 0 THEN  PRINT D$;"IN#0"  GET
     A$  IF  ASC (A$) = 13 THEN 2470
2410  IF Z <  > 2 THEN  PRINT  GOTO 2400
2420  IF TX < 0 OR TX > 279 OR TY < 0 OR TY > 191 OR (TX = X AND TY = Y) THEN
     2390
2430  IF TY > Y THEN  FOR ZZ = 1 TO TY - Y  CALL 25218  NEXT  GOTO 2450
2440  IF Y > TY THEN  FOR ZZ = 1 TO Y - TY  CALL 25175  NEXT
2450  IF TX > X THEN  FOR ZZ = 1 TO  INT ((TX - X) / 14)  CALL 25308  NEXT
      GOTO 2470
2460  IF X > TX THEN  FOR ZZ = 1 TO  INT ((X - TX) / 14)  CALL 25261  NEXT

2470  HCOLOR= 0  IF BC = 0 OR BC = 4 THEN  HCOLOR= 3
2480  GOSUB 1040  GOSUB 1330  HCOLOR= PC  GOSUB 1130  GOTO 170
2490  REM  *** DAVE'S SEPERATE ***
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2500 T3 = PC  GOSUB 670: IF PC = 4 OR PC = 0 THEN PC = T3: HCOLOR= PC: HOME
      PRINT   HTAB 9: PRINT "NO SEPARATION ON BLACKS.": GOSUB 1300: GOSUB
     1410: GOSUB 1130: GOTO 170
2510  IF PC = 3 THEN PC = T3: GOTO 2580
2520  PRINT D$;"PR#";SL: PRINT "~2,N". GOSUB 1330: HCOLOR= BC: GOSUB 1040:
      IF PC = 3 OR PC = 7 THEN  POKE 767,178: CALL 24576  GOTO 2570
2530  POKE 767,144: CALL 24576: T1 = 128: T2 = 213: IF PC = 2 THEN T2 = 170
2540  IF PC = 5 THEN T1 = 0: T2 = 213
2550  IF PC = 6 THEN T1 = 0: T2 = 170
2560  POKE 766,T1: POKE 767,T2: CALL 24911
2570 BC = 0: HCOLOR= 3  GOSUB 1040: GOSUB 1330
2580  HCOLOR= PC: GOSUB 1130: GOTO 170
2590  PRINT : PRINT D$;"PR#";SL
2600  PRINT "D,S";SF;",";H2;X";XF;",";Y";YF;",";R;N": RETURN
2610  TEXT : HOME : PRINT : HTAB 7: PRINT "TABLET INFORMATION FILE DOES".  PRINT
       HTAB 16: PRINT "NOT EXIST."
2620  VTAB 7  HTAB 8  PRINT "MAKE SURE THE MASTER DISK":  PRINT   HTAB 11  PRINT
     "IS NOT PROTECTED AND":  PRINT : HTAB 12: PRINT "THEN PRESS RETURN "
2630  VTAB 14: HTAB 5: PRINT "THE MENU ALIGNMENT ROUTINE WILL"  PRINT   HTAB
     17: PRINT "BE RUN. ";: GET A$: IF  ASC (A$) <  > 13 THEN 2630
2635  POKE 104,8: POKE 103,1
2640  PRINT   PRINT D$;"RUN MENU ALIGNMENT,D1": STOP
2650  REM  * ERROR HANDLER *
2660  TEXT : HOME :T7 =  PEEK (222): PRINT D$;"PR#0":  IF T7 = 9 THEN  VTAB
     12: HTAB 16: PRINT "I/O ERROR.": GOTO 2700
2670  IF T7 = 6 THEN  VTAB 12  HTAB 11: PRINT "PICTURE NOT ON DISK."  GOTO
     2700
2680  IF T7 = 4 OR T7 = 9 OR T7 = 10 THEN  VTAB 12: HTAB 8: PRINT "THE PIC
     TURE IS LOCKED, OR": HTAB 5: PRINT "THE DISK IS FULL, OR PROTECTED."
      GOTO 2700
2685  IF T7 = 13 THEN  VTAB 12: PRINT " FILE REQUESTED IS NOT A PICTURE FI
     LE.": GOTO 2700
2690  VTAB 12: HTAB 9: PRINT "PROBLEM --> PEEK(222)=",T7
2700  VTAB 20: HTAB 8: PRINT "PRESS SPACE BAR TO RETRY.": PRINT   HTAB 11:
      PRINT "PRESS <CR> TO ABORT "
2710  VTAB 24  HTAB 20: GET A$: IF A$ = " " THEN  VTAB 20  HTAB 1  CALL  -
     958: HTAB 15: PRINT "RETRYING   ": IF T7 = 6 THEN  GOTO 345
2715  IF A$ = " " THEN  RESUME
2720  IF  ASC (A$) = 13 THEN  PRINT   PRINT D$;"CLOSE ";D$  GOTO 290
2730  GOTO 2710
```

VARIABLE ATLAS

Name	Description
A$	General-purpose input string
AR	Calculated area for AREA command
B$	Input string for picture name in LOAD and SAVE
B1-B6	Temporary variables for WINDOW
BC	Background Color (defaults to 0)
BX	Pointer into the QUICK-DRAW subroutines
C$	String for slot number
CD	Termination code of QUICK-DRAW subroutines
CM	Current Command mode: 0 = DRAW 1 = LINES 2 = DOTS 3 = FRAME 4 = BOX
D$	CTRL-D (CHR$(4)) for DOS commands
DX	DELTA setting (0-127; negative if Audio Feedback is off)
DF	Default drive number for LOAD, SAVE, CATALOG

DT	Calculated distance for DISTANCE command
DX,DY	Temporary variables used in AREA and DISTANCE: the vertical and horizontal distance between a point and the next one.
E$	Temporary input string for SAVE
EP%	The beginning address of the QUICK-DRAW subroutines
GF	X screen offset values for WINDOW
H	Widely used as a temporary variable.
HF	Y screen offset values for WINDOW
LT	Length of menu, in Tablet units
M%	Maximum number of points for DISTANCE or AREA calculation
MD	Height and width of each menu command square, in Tablet units
N%	Index into arrays X% and Y%, used by QUICK-DRAW
PC	Pen color (0-7), defaults to 3 (white)
PI	Number of points per inch on the Tablet
RD	Flag for REDUCER mode: 1=on, 0=off.
RT	A return flag for LINES, DOTS, FRAME, and BOX modes whose value indicates the phase of the operation: 0 = Operation was just initialized. 1 = Menu selected; operation cancelled. 2 = Operation in progress.
S0	Scale setting for menu
S2	Scale setting for WINDOW after LOAD
SF	Scale Factor -- see XF,YF
SL	Slot number of Tablet Interface card (read from info file)
T1-T9	Temporary variables
TX,TY	Temporarily holds an X,Y position (for BOX, LINES, FRAME, SLIDE)
W	User CALIBRATE units
W$	Name of user CALIBRATE units
WM	CALIBRATE multiplier (WM= Tablet units / W)
X,Y	General-purpose coordinate pair for high-resolution screen
X%,Y%	Arrays (of length M%) which hold coordinates of points plotted in DRAW, AREA, and DISTANCE. They are filled by the QUICK-DRAW subroutines.
X1,Y1	Coordinates for upper-left corner of WINDOW on Tablet
X2,Y2	Coordinates for lower-right corner of WINDOW on Tablet
X3,Y3	Coordinates for upper-left corner of VIEWPORT on screen
X4,Y4	Coordinates for lower-right corner of VIEWPORT on screen
X5,Y5	Default values for X1,Y1
X6,Y6	Default values for X2,Y2
X8,Y8	Temporary X,Y coordinates (for VIEWPORT and color menu)
X9,Y9	" " "
XA,YA	Width and height of menu overlay
XB,YB	Coordinates for lower-right corner of WINDOW on screen
XF,YF	Current Tablet offset factors
XH,YH	Coordinates for upper-left corner of overlay on Tablet
XL,YL	Coordinates for lower-right corner of overlay on Tablet
XM,YM	Coordinates for upper-left corner of working area on Tablet
XT,YT	Coordinates for upper-left corner of WINDOW on screen
Z	Pen up/pen down value: 0 = pen is down, and has been down. 1 = pen is up 2 = pen newly down 10 = pen is off-scale Negative numbers indicate that a key has been pressed.
ZZ	Temporary variable used in delay loops.

SUBROUTINES

Entry	Description
530	Inputs drive number from keyboard
670	Displays color menu; returns chosen color in PC
880	Draws a single box of the color C9 on the low-resolution graphics screen. The box will be X8 blocks tall, and its upper-left corner will be at (X9, Y9).
1040	Draws the WINDOW on the high-resolution screen in the current HCOLOR.
1070	Sets scaling information for Tablet; falls into subroutine at 1090
1090	Turns off REDUCER, removes WINDOW frame and sets WINDOW to its default values, resets CALIBRATE setting, and falls into subroutine at 1120
1120	Stores VIEWPORT setting in memory for QUICK-DRAW
1130	Resets Tablet scaling information (with REDUCER, if active)
1280	Prints prompt "LOWER-RIGHT?"
1290	Prints prompt "UPPER-LEFT?"
1300	Delay 1.1 seconds
1310	Wait for the pen to be down or a keypress. If pen is down, return with coordinates in X,Y; if keypress, return with Z<0.
1330	Draws or undraws the four VIEWPORT corner marks.
1350	Draws or undraws a single VIEWPORT corner mark. The corner's coordinates are in X8,Y8 and the rotation factor is in H.
1400	Turns on the REDUCER.
1940	Returns with RT=1 if the last pen press was in the menu area; otherwise displays "POINT OUTSIDE VIEWPORT. RESPECIFY"
1990	Performs an AREA calculation on the polygon whose vertices are in the arrays X%,Y%. Returns with the area in AR.
2090	Performs a DISTANCE calculation on the closed curve whose points are in the arrays X%,Y%. Returns with the distance in DT.
2120	Adds the value of DT to the end of string B$, and prints it centered on the screen.
2300	Clears out the bottom four lines of the Page 2 Text screen.
2310	Displays the prompt "BEGINNING POINT?"
2320	Displays the prompt "ENDING POINT?"
2590	Reinitializes the Tablet with the scaling factor in SF, the X-offset in XF, and the Y-offset in YF.

SPECIAL LOCATIONS

These special memory locations are used by the TABLET-CODE APPLESOFT program. The decimal addresses are given on the left; hexadecimal equivalents are in parentheses and preceded by a dollar sign ($):

Location	Use
41 ($29)	This location contains the high part of the memory address of the beginning of the current line on the Text screen. A POKE 41, PEEK(41)+4 operation will cause the next printed line to appear on Page 2, rather than Page 1, of Text mode.
103,104 ($67,$68)	This pair of locations holds the address of the beginning of the current Applesoft program in memory.
222 ($DE)	This location holds the ON ERR GOTO code of the last error generated.
232,233 ($E8,$E9)	This pair of locations holds the address of the beginning of the current shape table for the Applesoft DRAW and XDRAW commands.
700 ($2BC)	Holds the termination code from the QUICK-DRAW subroutines.
752,753 ($2F0,$2F1)	After the QUICK-DRAW program is RUN, this pair of locations will hold the memory address of the beginning of the QUICK-DRAW subroutine.
766,767 ($2FE,$2FF)	These locations are used to pass the selected color to the SEPARATE subroutine.
3089-3094 ($C11-$C16)	These locations are used to pass VIEWPORT information to the QUICK-DRAW subroutine.
16632,16633 ($40F8,$40F9)	These locations are in the memory range used by the high-resolution graphics Page 2, but their contents are neither displayed on the screen or affected by normal screen operations. These two locations are used to store the value of S2 during a SAVE.
16504-16511 ($4078-$407F)	These are also locations in the high-resolution Page 2 which are not displayed. These eight locations are used to store the values of X1, X2, Y1, and Y2 during a SAVE.
24576 ($6000)	This is the entry point for the machine language subroutine which performs a SEPARATE.

24911 ($614F) This is another entry point for SEPARATE.

25175 ($6257) Entry point for a one-dot SLIDE down.

25218 ($6282) Entry point for a one-dot SLIDE up.

25261 ($62AD) Entry point for a 14-dot SLIDE right.

25308 ($62DC) Entry point for a 14-dot SLIDE left.

-16368 ($C010) A PEEK or POKE to this location will clear the Apple's keyboard strobe, causing any recent keypress to be ignored.

62454 ($F3F6) This subroutine in the Applesoft ROM fills the entire high-resolution screen with the most recent HCOLOR plotted.

-958 ($FC42) This subroutine in the Apple's Monitor ROM clears the text screen from the current cursor position to the end of the screen.

-868 ($FC9C) This subroutine in the Apple's Monitor ROM clears the text screen from the current cursor position to the end of the line.

ROM CODE

```
SOURCE FILE: BITPAD35.1P
SOURCE FILE: BITPAD35.2P
0000                1 ********************
0000                2 *
0000                3 *
0000                4 *      BIT PAD FIRMWARE
0000                5 *
0000                6 *   COPYRIGHT APPLE COMPUTER
0000                7 *    7/30/79
0000                8 *    W SANDER
0000                9 *
0000               10 *
0000               11 ********************
0024               12 CH          EQU   $24          ;SCREEN HORIZONTAL POSITION
002A               13 HBASL       EQU   $2A          ;BASE ADDRESS FOR BITPAD CURSOR
0028               14 HBASH       EQU   $28
0028               15 BASL        EQU   $28          ;TEXT BASE ADDRESS
0036               16 COUTL       EQU   $36          ;LOW BYTE OF COUT POINTER
0037               17 COUTH       EQU   $37          ;HIGH BYTE OF COUT POINTER
0200               18 IN0         EQU   $200         ;INPUT BUFFER ADDRESSES
0201               19 IN1         EQU   $201
0202               20 IN2         EQU   $202
0203               21 IN3         EQU   $203
0280               22 TEM         EQU   $280         ;RETURN FLAG LOCATION
0000               23 *  ;HIGH NIBBLE - 1=RETURN SCALED VALUE
0000               24 *  ;LOW NIBBLE - 0=PEN DOWN, 1=PEN LIFT, 2=PEN FALL, 3=PEN UP
0281               25 XFLL        EQU   $281         ;X-COORD LOW BYTE, FULL SCALE
0282               26 XFLH        EQU   $282         ;X-COORD HIGH BYTE, FULL SCALE
0283               27 YFLL        EQU   $283         ;Y-COORD LOW BYTE,FULL SCALE
0284               28 YFLH        EQU   $284         ;Y-COORD HIGH BYTE, FULL SCALE
0285               29 TENXL       EQU   $285         ;X-COORD LOW BYTE,SCALED
0286               30 TENX        EQU   $286         ;X-COORD HIGH BYTE, SCALED
```

```
0287:            31 TEMYL     EQU   $287        ;Y-COORD LOW BYTE, SCALED
0288:            32 TEMY      EQU   $288         ;Y-COORD HIGH BYTE, SCALED
0287:            33 REGL      EQU   $287         ;DIVIDE REGISTERS
0288:            34 REGH      EQU   $288
0290:            35 INA       EQU   $290         ;BUFFER REGISTER FOR PR# SYNTAX
0298:            36 INX       EQU   $298         ;PR# BUFFER POINTER
0299:            37 NFLAG     EQU   $299         ;PR# BUFFER STATUS FLAG
0298:            38 SAVSLOT   EQU   $29B
02A0:            39 MIFLAG    EQU   $2A0
02A1:            40 OREGL     EQU   $2A1
02A2:            41 OREGH     EQU   $2A2
02A3:            42 DIVL      EQU   $2A3
02A4:            43 DIVH      EQU   $2A4
02A5:            44 CIHAR     EQU   $2A5
0388:            45 PAGE      EQU   $388         ;PAGE CODE:
0000:            46 *
0000:            47 * HIGH BIT = 1 MEANS SCALE DATA
0000:            48 * 40 = HIRES PAGE2
0000:            49 * 20 = HIRES PAGE1
0000:            50 * 08 = TEXT PAGE2
0000:            51 * 04 = TEXT PAGE1
0000:            52 * 02 = LORES PAGE2
0000:            53 * 01 = LORES PAGE1
0000:            54 * 42 = HIRES MIXED PAGE2
0000:            55 * 21 = HIRES MIXED PAGE1
0000:            56 * 0A = LORES MIXED PAGE2
0000:            57 * 05 = LORES MIXED PAGE1
0000:            58 *
0438:            59 MPAGE     EQU   $438
0000:            60 *
0000:            61 * LAST SIX BITS OF MPAGE CORRESPOND TO PAGE
0000:            62 * BIT 7 MEANS STREAM MODE IF 1
0000:            63 * BIT 6 MEANS OFFSET AFTER SCALE IF 1
0000:            64 *
0488:            65 SCALL     EQU   $488         ;LOW BYTE OF SCALE FACTOR
0538:            66 SCALH     EQU   $538         ;HIGH BYTE OF SCALE FACTOR
0588:            67 OFFXL     EQU   $588         ;LOW BYTE OF X-OFFSET
0638:            68 OFFXH     EQU   $638         ;HIGH BYTE OF X-OFFSET
0688:            69 OFFYL     EQU   $688         ;LOW BYTE OF Y-OFFSET
0738:            70 OFFYH     EQU   $738         ;HIGH BYTE OF Y OFFSET
0678:            71 HNDX      EQU   $678         ;TEMP INDEX FOR CURSOR PLOT
0578:            72 TEMPL     EQU   $578
05F8:            73 TEMPH     EQU   $5F8
02A5:            74 COUNT     EQU   $2A5         ;UTILITY COUNT REG
06F8:            75 CHAR      EQU   $6F8         ;TEMPORARY CHARACTER STORE
07F8:            76 MSLOT     EQU   $7F8         ;CURRENT SLOT POINTER *CN
C000:            77 KBD       EQU   $C000         ;KEYBOARD STROBE
C010:            78 KBDSTRB   EQU   $C010         ;KEYBOARD STROBE RESET
C050:            79 SGR       EQU   $C050        ;DISPLAY MODE REFERENCES
C051:            80 STEXT     EQU   $C051
C052:            81 SNMIX     EQU   $C052
C053:            82 SMIX      EQU   $C053
C054:            83 SPAG1     EQU   $C054
C055:            84 SPAG2     EQU   $C055
C056:            85 SLORES    EQU   $C056
C057:            86 SHIRES    EQU   $C057
C081:            87 DEV0      EQU   $C081         ;BITPAD DEVICE ADDRESSES
C080:            88 DEV1      EQU   $C080
C083:            89 DEV2      EQU   $C083
C082:            90 DEV3      EQU   $C082
CFFF:            91 ROMSW     EQU   $CFFF        ;REFERENCE ADDRESS TO FREE $C800 I
FE93:            92 SETVID    EQU   $FE93         ;SET CHARACTER OUTPUT TO NORMAL
FDED:            93 COUT      EQU   $FDED         ;CHARACTER OUTPUT
FF58:            94 IORTS     EQU   $FF58         ;UTILITY LOCATION CONTAINING 'RT
0000:            96 ********************
0000:            97 *
0000:            98 * CN00 ROM ENTRY
0000:            99 * FLAG SET-UP:  C CLEAR FOR IN# ENTRY
0000:           100 * C SET FOR POINT RETURN (CURSOR)
0000:           101 *
0000:           102 * CN00 ENTRY CODE REPLICATED FOR EACH
0000:           103 * N FROM 9 TO F (CORRESPONDING TO 1 TO 7)
0000:           104 *
0000:           105 ********************
```

```
0000:             107 **********************
0000:             108 *
0000:             109 * C800 SPACE ENTRY
0000:             110 *
0000:             111 * GET SLOT NO. SAVE MSLOT,
0000:             112 * AND SET DEFAULTS
0000:             113 *
0000:             114 **********************
------ NEXT OBJECT FILE NAME IS XX
C800:             115             ORG   $C800
0000:             116             OBJ   $6000
C800:8D A5 02     117 OTHROM      STA   C1HAR         ;SAVE ACCUM FOR PR# ROUTINE
C803:68           118             PLA                 ;PULL RETURN VECTOR TO
C804:68           119             PLA                 ;GET SLOT NO.
C805:28           120             PLP
C806:50 01        121             BVC   AOTHROM
C808:60           122             RTS
C809:8D F8 07     123 AOTHROM     STA   MSLOT         ;SAVE SLOT NO.
C80C:8D 78 02     124             STA   SAVSLOT
C80F:AD A5 02     125             LDA   C1HAR
C812:8D F8 06     126             STA   CHAR
C815:48           127             PHA                  ;SAVE ACCUM
C816:8A           128             TXA                 ;SAVE X-REG AND Y-REG
C817:48           129             PHA
C818:98           130             TYA
C819:48           131             PHA
C81A:08           132             PHP                 ;SAVE STATUS
C81B:AE F8 07     133             LDX   MSLOT         ;LOAD X FOR SLOT DEP VARS
C81E:BD 38 04     134             LDA   MPAGE,X
C821:49 25        135             EOR   #$25
C823:5D 88 03     136             EOR   PAGE,X
C826:29 3F        137             AND   #$3F
C828:F0 03        138             BEQ   PRCHK         ;IF SO THEN NO DEFAULT
C82A:20 90 CE     139             JSR   DEFAULT
C82D:E4 37        140 PRCHK       CPX   COUTH         ;CHECK IF FROM PR#
C82F:D0 03        141             BNE   NOPR
C831:4C AD CC     142             JMP   SYNTAX        ;IF SO, THEN TAKE IN COMMANDS
C834:28           143 NOPR        PLP                 ;RECOVER STATUS
C835:08           144             PHP                 ;AND SAVE
C836:B0 07        145             BCS   EPOINT
C838:AD F8 06     146             LDA   CHAR
C838:A4 24        147             LDY   CH
C83D:91 28        148             STA   (BASL),Y      ;ELIM FLASHING CURSOR
C83F.             150 **********************
C83F:             151 **********************
C83F:             152 *
C83F:             153 * MAIN LOOP ENTRY
C83F:             154 *
C83F:             155 **********************
C83F:             156 **********************
C83F:20 B9 C8     157 EPOINT      JSR   MREAD         ;READ BITPAD
C842:2C 00 C0     158             BIT   KBD
C845:30 26        159             BMI   END
C847:AD B0 02     160             LDA   TEM           ;CHECK IF PEN DOWN
C84A:29 03        161             AND   #$3
C84C:C9 03        162             CMP   #$3
C84E:D0 1D        163             BNE   END           ;EXIT IF PEN DOWN
C850:AC F8 07     164             LDY   MSLOT
C853:B9 88 03     165             LDA   PAGE,Y
C856:29 7F        166             AND   #$7F
C858:F0 0E        167             BEQ   E1PNT
C85A:20 F0 C8     168             JSR   CURSOUT       ;DRAW CURSOR
C85D:A9 60        169             LDA   #$60
C85F:20 A1 CC     170             JSR   GWAIT         ;LEAVE CURSOR ON FOR AWHILE
C862:20 F0 C8     171             JSR   CURSOUT       ;THEN DELETE CURSOR
C865:AC F8 07     172             LDY   MSLOT
C868:B9 38 04     173 E1PNT       LDA   MPAGE,Y
C86B:10 D2        174             BPL   EPOINT
```

```
C86D:            176 ********************
C86D:            177 ********************
C86D:            178 *
C86D:            179 * EXIT ROUTINES
C86D             180 *
C86D             181 ********************
C86D             182 ********************
C86D:A2 03       183 END       LDX   #$3
C86F:BD 81 02    184 INEX1     LDA   XFLL,X      ;COPY RESULTS TO TEM REGISTERS
C872:9D 85 02    185           STA   TEMXL,X
C875:CA          186           DEX
C876:10 F7       187           BPL   INEX1
C878:AE F8 07    188           LDX   MSLOT       ;TEST HIGH BIT OF 'PAGE' TO
C87B:BD 88 03    189           LDA   PAGE,X      ;SEE IF DATA IS TO BE SCALED
C87E:10 03       190           BPL   INEX2
C880:20 70 C8    191           JSR   SCALE       ;SCALE AND OFFSET DATA INTO TEM-R
C883:28          192 INEX2     PLP
C884:90 06       193           BCC   INEXIT      ;SKIP TO FURTHER PROCESSING
C886:68          194 EXIT      PLA
C887:A8          195           TAY
C888:68          196           PLA               ;RESTORE REGISTERS AND EXIT
C889:AA          197           TAX               ;IF NOT FROM IN#
C88A:68          198           PLA
C88B:60          199           RTS
C88C:            200 *
C88C:            201 * SET INPUT BUFFER TO +0000.+0000.+00
C88C:            202 *
C88C:            203 ********************
C88C:A9 B0       204 INEXIT    LDA   #$B0
C88E:A0 0E       205           LDY   #$E
C890:99 00 02    206 GLOOP     STA   IND,Y
C893:88          207           DEY
C894:10 FA       208           BPL   GLOOP
C896:A9 AB       209           LDA   #$AB
C898:8D 00 02    210           STA   $200
C89B:8D 06 02    211           STA   $206
C89E:8D 0C 02    212           STA   $20C
C8A1:A9 AC       213           LDA   #$AC
C8A3:8D 05 02    214           STA   $205
C8A6:8D 0B 02    215           STA   $20B
C8A9:AD 80 02    216           LDA   TEM
C8AC:29 10       217           AND   #$10
C8AE:D0 16       218           BNE   ASCEX
C8B0:AD 85 02    219           LDA   TEMXL
C8B3:AC 86 02    220           LDY   TEMX        ;CONVERT X TO ASCII
C8B6:A2 00       221           LDX   #$0         ;IN INPUT BUFFER
C8B8:20 6A CA    222           JSR   ASCON
C8BB:AD 87 02    223           LDA   TEMYL
C8BE:AC 88 02    224           LDY   TEMY
C8C1:A2 06       225           LDX   #$6         ;CONVERT Y TO ASCII
C8C3:20 6A CA    226           JSR   ASCON       ;IN INPUT BUFFER
C8C6:2C 00 C0    227 ASCEX     BIT   KBD
C8C9:10 09       228           BPL   ASCIEX
C8CB:A9 AD       229           LDA   #$AD
C8CD:8D 0C 02    230           STA   $20C
C8D0:AD 80 02    231 ASCIEX    LDA   TEM
C8D3:48          232           PHA
C8D4:29 0F       233           AND   #$0F        ;SET UP RETURN FLAG IN INPUT BUFF
C8D6:09 B0       234           ORA   #$B0
C8D8:8D 0E 02    235           STA   $20E
C8DB:68          236           PLA
C8DC:4A          237           LSR   A
C8DD:4A          238           LSR   A
C8DE:4A          239           LSR   A
C8DF:4A          240           LSR   A
C8E0:29 0F       241           AND   #$0F
C8E2:09 B0       242           ORA   #$B0
C8E4:8D 0D 02    243           STA   $20D
C8E7:A8          244           TAY
C8E8:68          245           PLA               ;PULL STACK AND SET UP
C8E9:68          246           PLA               ;REGISTERS FOR END OF LINE
C8EA:68          247           PLA
C8EB:A2 0F       248           LDX   #$0F
C8ED:A9 8D       249           LDA   #$8D
C8EF:60          250           RTS
```

```
C8F0:                252 **********************
C8F0:                253 **********************
C8F0:                254 *
C8F0:                255 * CURSOR ROUTINE
C8F0:                256 *
C8F0:                257 **********************
C8F0:                258 **********************
C8F0: 20 70 CB       259 CURSOUT   JSR   SCALE
C8F3: 4C 0C C9       260           JMP   C15KP
C900:                261           ORG   $100+OTHROM
C900: 18             262 INPUTXY   CLC                  ;CARRY SET FOR INH ENTRY
C901: B0             263           DFB   $B0             ;SKIP NEXT BYTE
C902: 38             264 POINT     SEC                  ;SET CARRY FOR ENTRY TO GET A POI
C903: B8             265           CLV
C904: 08             266           PHP                  ;SAVE FLAGS FOR LATER
C905: 78             267           SEI                  ;DISABLE INTERRUPT UNTIL MSLOT $F
C906: 2C FF CF       268           BIT   ROMSW          ;SWITCH OFF ALL $C800 ROMS
C909: 20 00 C8       269           JSR   OTHROM         ;SWITCH TO $C800 SPACE
C90C: A5 2A          270 C15KP     LDA   HBASL
C90E: 48             271           PHA
C90F: A5 2B          272           LDA   HBASH
C911: 48             273           PHA
C912: AD 87 02       274           LDA   TEMYL
C915: AE 85 02       275           LDX   TEMXL
C918: 20 4C CA       276 CALLCURS  JSR   WINCHK
C91B: 48             277           PHA
C91C: B0 30          278           BCS   OUT1
C91E: 20 F0 C9       279           JSR   BASCLC
C921:                280 **************************
C921:                281 *
C921:                282 * MODE EVALUATION
C921:                283 *
C921:                284 **************************
C921: B9 B8 03       285           LDA   PAGE.Y
C924: 29 7F          286           AND   #$7F
C926: A8             287           TAY
C927: 29 0C          288           AND   #$0C
C929: F0 26          289           BEQ   GR
C92B: 98             290           TYA
C92C: 29 63          291           AND   #$63
C92E: F0 06          292           BEQ   TEXT
C930: 68             293 MIX       PLA                  ;MIXED GRAPHICS BOUNDARY TEST
C931: 48             294           PHA
C932: C9 A0          295           CMP   #160
C934: 90 1B          296           BCC   GR
C936:                297 **************************
C936:                298 *
C936:                299 * TEXT MODE CURSOR GENERATION
C936:                300 *
C936:                301 **************************
C936: 98             302 TEXT      TYA
C937: 20 DE C9       303           JSR   LOCLC
C93A: B1 2A          304           LDA   (HBASL),Y
C93C: 48             305           PHA
C93D: A9 DF          306           LDA   #$DF
C93F: 91 2A          307           STA   (HBASL),Y
C941: A9 80          308           LDA   #$80
C943: 20 A1 CC       309           JSR   GWAIT
C946: 68             310           PLA
C947: 91 2A          311           STA   (HBASL),Y
C949: 49 60          312           LDA   #$60
C94B: 20 A1 CC       313           JSR   GWAIT
C94E: 4C D0 C9       314 OUT1      JMP   OUT
C951: 98             315 GR        TYA                  ;TEST FOR HIRES VS LORES GRAPHICS
C952: C9 0F          316           CMP   #$0F
C954: B0 1B          317           BCS   HIRES
C956: A5 2B          318           LDA   HBASH
C958: 29 10          319           AND   #$10
C95A:                320 *********
C95A:                321 *
C95A:                322 * LO RESOLUTION GRAPHICS
C95A:                323 * CURSOR ROUTINE
C95A:                324 *
C95A:                325 ********
```

```
C95A:08          326 LORES     PHP
C95B:A9 F0       327           LDA   #$F0
C95D:28          328           PLP
C95E:D0 02       329           BNE   LOR1
C960:49 FF       330           EOR   #$FF
C962:48          331 LOR1      PHA
C963:98          332           TYA
C964:0A          333           ASL   A
C965:0A          334           ASL   A
C966:20 DE C9    335           JSR   LOCLC
C969:68          336           PLA
C96A:51 2A       337           EOR   (HBASL),Y
C96C:91 2A       338           STA   (HBASL),Y
C96E:4C D0 C9    339           JMP   OUT
C971:            340 **********
C971:            341 *
C971:            342 * HIRES CURSOR ROUTINE
C971:            343 *
C971:            344 **********
C971:A9 16       345 HIRES     LDA   #$16
C973:8D A5 02    346           STA   COUNT
C976:8A          347           TXA
C977:38          348           SEC
C978:E9 05       349           SBC   #$5
C97A:AA          350           TAX
C97B:B0 03       351           BCS   LOOP
C97D:CE 86 02    352           DEC   TEMX
C980:A0 05       353 LOOP      LDY   #$5
C982:AD A5 02    354           LDA   COUNT
C985:D9 DB C9    355 CTRLOOP   CMP   CTRCHK,Y
C988:F0 14       356           BEQ   OUTSIDE
C98A:88          357           DEY
C98B:10 F8       358           BPL   CTRLOOP
C98D:68          359           PLA
C98E:20 4C CA    360           JSR   WINCHK
C991:48          361           PHA
C992:B0 0A       362           BCS   OUTSIDE
C994:20 F0 C9    363           JSR   BASCLC
C997:AC 78 06    364           LDY   HNDX
C99A:51 2A       365           EOR   (HBASL),Y
C99C:91 2A       366           STA   (HBASL),Y
C99E:A9 0C       367 OUTSIDE   LDA   #$C
C9A0:CD A5 02    368           CMP   COUNT
C9A3:F0 0E       369           BEQ   A
C9A5:B0 1D       370           BCS   B
C9A7:E8          371           INX
C9A8:D0 03       372           BNE   C
C9AA:EE 86 02    373           INC   TEMX
C9AD:CE A5 02    374 C         DEC   COUNT
C9B0:4C B0 C9    375           JMP   LOOP
C9B3:8A          376 A         TXA
C9B4:E9 05       377           SBC   #$5
C9B6:AA          378           TAX
C9B7:AD 86 02    379           LDA   TEMX
C9BA:E9 00       380           SBC   #$0
C9BC:8D 86 02    381           STA   TEMX
C9BF:68          382           PLA
C9C0:38          383           SEC
C9C1:E9 06       384           SBC   #$6
C9C3:48          385           PHA
C9C4:68          386 B         PLA
C9C5:18          387           CLC
C9C6:69 01       388           ADC   #$1
C9C8:48          389           PHA
C9C9:CE A5 02    390           DEC   COUNT
C9CC:F0 02       391           BEQ   OUT
C9CE:D0 B0       392           BNE   LOOP
C9D0:68          393 OUT       PLA
C9D1:68          394           PLA
C9D2:85 2B       395           STA   HBASH
C9D4:68          396           PLA
C9D5:85 2A       397           STA   HBASL
C9D7:60          398           RTS
```

```
C9D8 12          399 CTRCHK    DFB   #12
C9D9 11          400           DFB   #11
C9DA 10          401           DFB   #10
C9DB 07          402           DFB   #7
C9DC 06          403           DFB   #6
C9DD 05          404           DFB   #5
C9DE             405 ***********************
C9DE             406 * TEXT BASE CALC
C9DE             407 *
C9DE             408 * THIS SUBROUTINE SETS UP BASE REGISTER
C9DE             409 * FOR LORES OR TEXT
C9DE             410 * ENTER WITH 'PAGE' IN A --
C9DE             411 * EXIT WITH HNDX IN Y. READY FOR SCREEN PROCESSING
C9DE             412 *
C9DE             413 ***********************
C9DE: 48         414 LOCLC     PHA
C9DF: A5 2B      415           LDA   HBASH
C9E1: 29 03      416           AND   #$3
C9E3: 85 2B      417           STA   HBASH
C9E5: 68         418           PLA
C9E6: 29 0C      419           AND   #$0C
C9E8: 05 2B      420           ORA   HBASH
C9EA: 85 2B      421           STA   HBASH
C9EC: AC 78 06   422           LDY   HNDX
C9EF: 60         423           RTS
C9F0             425 ****************************
C9F0             426 *
C9F0             427 * SCREEN BASE ADDRESS CALC
C9F0             428 *
C9F0             429 * ENTER WITH LO BYTE OF Y IN ACCUM
C9F0             430 * AND WITH LO BYTE OF X IN X-REG
C9F0             431 *
C9F0             432 * BASE ADDRESS WILL BE COMPUTED INTO
C9F0             433 * HBASL,HBASH, AND HNDX. HIRES BIT ADRESSED
C9F0             434 * IS RETURNED AS A 1 IN A BIT IN THE ACCUM
C9F0             435 *
C9F0             436 ****************************
C9F0: 48         437 BASCLC    PHA
C9F1: 29 C0      438           AND   #$C0
C9F3: 85 2A      439           STA   HBASL
C9F5: 4A         440           LSR   A
C9F6: 4A         441           LSR   A
C9F7: 05 2A      442           ORA   HBASL
C9F9: 85 2A      443           STA   HBASL
C9FB: 68         444           PLA
C9FC: 4C 0C CA   445           JMP   C2SKP
CA00             446           ORG   $200+OTHROM
CA00: 1B         447           CLC                    ;$C200 SPACE ENTRY
CA01: B0         448           DFB   $B0
CA02: 38         449           SEC
CA03: B8         450           CLV
CA04: 08         451           PHP
CA05: 78         452           SEI
CA06: 2C FF CF   453           BIT   ROMSW
CA09: 20 00 CB   454           JSR   OTHROM
CA0C: 85 2B      455 C2SKP     STA   HBASH
CA0E: 0A         456           ASL   A
CA0F: 0A         457           ASL   A
CA10: 0A         458           ASL   A
CA11: 26 2B      459           ROL   HBASH
CA13: 0A         460           ASL   A
CA14: 26 2B      461           ROL   HBASH
CA16: 0A         462           ASL   A
CA17: 66 2A      463           ROR   HBASL
CA19: A5 2B      464           LDA   HBASH
CA1B: 29 1F      465           AND   #$1F
CA1D: 85 2B      466           STA   HBASH
CA1F: 8A         467           TXA
CA20: AC 86 02   468           LDY   TEMX
CA23: C0 00      469           CPY   #$0
CA25: F0 05      470           BEQ   HPOSN2
CA27: A0 23      471           LDY   #$23
CA29: 69 04      472           ADC   #$4
```

```
CA23 C8          473 HPOSN1     INY
CA2C E9 07       474 HPOSN2     SBC   #$7
CA2E: B0 FB      475            BCS   HPOSN1
CA30: 69 08      476            ADC   #$8
CA32: 8C 78 06   477            STY   WNDX
CA35: A8         478            TAY
CA36: A9 00      479            LDA   #$0
CA38: 38         480            SEC
CA39: 2A         481 CLOOP      ROL   A
CA3A: 88         482            DEY
CA3B: D0 FC      483            BNE   CLOOP
CA3D: AC F8 07   484            LDY   MSLOT
CA40: 48         485            PHA
CA41: B9 B8 03   486            LDA   PAGE,Y
CA44: 29 60      487            AND   #$60
CA46: 05 28      488            ORA   HBASH
CA48: 85 28      489            STA   HBASH
CA4A: 68         490            PLA
CA4B: 60         491            RTS
CA4C:            492            CHN   BITPAD35.2P
CA4C:              2 ********************
CA4C:              3 *
CA4C:              4 * WINDOW CHECK SUBROUTINE
CA4C:              5 *
CA4C:              6 * ENTER WITH LO BYTE OF Y IN ACCUM
CA4C:              7 * AND LO BYTE OF X IN X-REG
CA4C:              8 *
CA4C:              9 * RETURN WILL BE CARRY CLEAR IF
CA4C:             10 * WITHIN WINDOW AND CARRY SET IF
CA4C:             11 * OUTSIDE.
CA4C:             12 *
CA4C:             13 ********************
CA4C: 48          14 WINCHK      PHA
CA4D: C9 C0       15             CMP   #192
CA4F: B0 16       16             BCS   NO
CA51: AD 86 02    17             LDA   TEMX
CA54: F0 09       18             BEQ   YES
CA56: C9 02       19             CMP   #$2
CA58: B0 0D       20             BCS   NO
CA5A: 8A          21             TXA
CA5B: C9 18       22             CMP   #24
CA5D: B0 08       23             BCS   NO
CA5F: AD 88 02    24 YES         LDA   TEMY
CA62: D0 03       25             BNE   NO
CA64: 18          26             CLC
CA65: 68          27             PLA
CA66: 60          28             RTS
CA67: 38          29 NO          SEC
CA68 68           30             PLA
CA69: 60          31             RTS
CA6A:             33 ********************
CA6A              34 *
CA6A:             35 * ASCII CONVERSION
CA6A:             36 * ENTER WITH HIGH BYTE
CA6A:             37 * IN Y-REG, LOW BYTE IN ACCUM
CA6A:             38 * AND INPUT BUFFER OFFSET
CA6A:             39 * IN X-REG
CA6A:             40 *
CA6A:             41 ********************
CA6A: 48          42 ASCON       PHA
CA6B: 98          43             TYA
CA6C: 10 12       44             BPL   POSIT
CA6E: 48          45             PHA
CA6F: A9 AD       46             LDA   #$AD
CA71: 9D 00 02    47             STA   IN0,X
CA74: 68          48             PLA
CA75: 86 2A       49             STX   HBASL
CA77: AA          50             TAX
CA78: 68          51             PLA
CA79: 20 5B CB    52             JSR   TWOCOM
CA7C: 48          53             PHA
CA7D: 8A          54             TXA
CA7E: A6 2A       55             LDX   HBASL
```

```
CA80:A8          56 POSIT     TAY
CA81:E8          57           INX
CA82:68          58           PLA
CA83:38          59           SEC
CA84:B0 03       60           BCS   ASKIP
CA86:FE 00 02    61 FLOOP     INC   IN0,X
CA89:E9 E8       62 ASKIP     SBC   #$E8
CA8B:48          63           PHA
CA8C:98          64           TYA
CA8D:E9 03       65           SBC   #$3
CA8F:A8          66           TAY
CA90:68          67           PLA
CA91:B0 F3       68           BCS   FLOOP
CA93:69 E8       69           ADC   #$E8
CA95:48          70           PHA
CA96:98          71           TYA
CA97:69 03       72           ADC   #$3
CA99:A8          73           TAY
CA9A:68          74           PLA
CA9B:B0 03       75           BCS   BSKIP
CA9D:FE 01 02    76 HLOOP     INC   IN1,X
CAA0:38          77 BSKIP     SEC
CAA1:E9 64       78           SBC   #$64
CAA3:B0 F8       79           BCS   HLOOP
CAA5:88          80           DEY
CAA6:10 F5       81           BPL   HLOOP
CAA8:18          82           CLC
CAA9:C8          83           INY
CAAA:69 64       84           ADC   #$64
CAAC:38          85           SEC
CAAD:B0 03       86           BCS   CSKIP
CAAF:FE 02 02    87 JLOOP     INC   IN2,X
CAB2:E9 0A       88 CSKIP     SBC   #$A
CAB4:B0 F9       89           BCS   JLOOP
CAB6:69 0A       90           ADC   #$A
CAB8:B0 03       91           BCS   DSKIP
CABA:FE 03 02    92 KLOOP     INC   IN3,X
CABD:E9 01       93 DSKIP     SBC   #$1
CABF:B0 F9       94           BCS   KLOOP
CAC1:60          95 RTN       RTS
CAC2:            97 *********************
CAC2:            98 *
CAC2:            99 * OFFSET AND DIVIDE ROUTINE
CAC2:           100 *
CAC2:           101 * ENTER WITH OFFSET IN REGH
CAC2:           102 * AND REGL, VALUE TO SCALE IN
CAC2:           103 * X (HIGH BYTE) AND A (LOW BYTE)
CAC2:           104 * SCALE (INTEGER DIVISOR) IN
CAC2:           105 * DIVH AND DIVL
CAC2:           106 *
CAC2:           107 * RESULT IN REGH AND REGL
CAC2:           108 * VALUE MAY BE +OR-32767
CAC2:           109 * SCALE 0 TO +32767
CAC2:           110 * RESULT IS TWOS COMPLEMENT
CAC2:           111 * REMAINDER IS LOST
CAC2            112 *
CAC2.           113 *********************
CAC2.AC F8 07   114 OFFDIV   LDY   MSLOT
CAC5 48         115          PHA
CAC6 B9 38 04   116          LDA   MPAGE,Y
CAC9 0A         117          ASL   A
CACA 30 05      118          BMI   DIVIDE
CACC 68         119          PLA
CACD 20 64 CB   120          JSR   OFFSET
CAD0 48         121          PHA
CAD1 B8         122 DIVIDE   CLV
CAD2 A0 00      123          LDY   #$0
CAD4 AD A4 02   124          LDA   DIVH
CAD7 C8         125 LOOP1    INY
CAD8 0E A3 02   126          ASL   DIVL
CADB 2A         127          ROL   A
CADC 10 F9      128          BPL   LOOP1
CADE 8D A4 02   129          STA   DIVH
```

```
CAE1:A9 00     130           LDA   #$0
CAE3 8D 88 02  131           STA   REQH
CAE6.8D 87 02  132           STA   REQL
CAE9 68        133           PLA
CAEA E8        134           INX
CAEB.CA        135           DEX
CAEC.08        136           PHP
CAED 10 03     137           BPL   POS
CAEF:20 98 CB  138           JSR   TWOCOM
CAF2:38        139 POS       SEC
CAF3.ED A3 02  140 LOOP2     SBC   DIVL
CAF6 48        141           PHA
CAF7 8A        142           TXA
CAF8:ED A4 02  143           SBC   DIVH
CAFB.AA        144           TAX
CAFC:68        145           PLA
CAFD:4C 0C CB  146           JMP   LOOP3
CB00:          147           ORG   $300+OTHROM
CB00:18        148           CLC                   ;$C300 SPACE ENTRY
CB01:80        149           DFB   $80
CB02:38        150           SEC
CB03:B8        151           CLV
CB04:08        152           PHP
CB05:78        153           SEI
CB06:2C FF CF  154           BIT   ROMSW
CB09:20 00 C8  155           JSR   OTHROM
CB0C.08        156 LOOP3     PHP
CB0D:2E 87 02  157           ROL   REQL
CB10:2E 88 02  158           ROL   REQH
CB13:88        159           DEY
CB14:30 16     160           BMI   FEXIT
CB16:4E A4 02  161           LSR   DIVH
CB19:6E A3 02  162           ROR   DIVL
CB1C:28        163           PLP
CB1D:B0 D4     164           BCS   LOOP2
CB1F:6D A3 02  165 LOOP4     ADC   DIVL
CB22:48        166           PHA
CB23:8A        167           TXA
CB24.6D A4 02  168           ADC   DIVH
CB27:AA        169           TAX
CB28:68        170           PLA
CB29:4C 0C CB  171           JMP   LOOP3
CB2C:28        172 FEXIT     PLP
CB2D:28        173 DEXIT     PLP
CB2E:10 0F     174           BPL   EEXIT
CB30:AD 87 02  175           LDA   REQL
CB33:AE 88 02  176           LDX   REQH
CB36:20 58 CB  177           JSR   TWOCOM
CB39:8E 88 02  178           STX   REQH
CB3C 8D 87 02  179           STA   REQL
CB3F:AC F8 07  180 EEXIT     LDY   MSLOT
CB42:B9 38 04  181           LDA   MPAGE,Y
CB45:0A        182           ASL   A
CB46:10 0F     183           BPL   E1EXIT
CB48:AD 87 02  184           LDA   REQL
CB4B:AE 88 02  185           LDX   REQH
CB4E:20 64 CB  186           JSR   OFFSET
CB51:8D 87 02  187           STA   REQL
CB54:8E 88 02  188           STX   REQH
CB57:60        189 E1EXIT    RTS
CB58:49 FF     190 TWOCOM    EOR   #$FF
CB5A:18        191           CLC
CB5B:69 01     192           ADC   #$1
CB5D:48        193           PHA
CB5E:8A        194           TXA
CB5F:49 FF     195           EOR   #$FF
CB61:AA        196           TAX
CB62:68        197           PLA
CB63:60        198           RTS
CB64:38        199 OFFSET    SEC
CB65:ED A1 02  200           SBC   OREQL
CB68:48        201           PHA
CB69:8A        202           TXA
```

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CB6A: ED A2 02  203           SBC   OREGH
CB6D: AA        204           TAX
CB6E: 68        205           PLA
CB6F: 60        206           RTS
CB70            208 ********************
CB70:           209 *
CB70:           210 * SCALE ROUTINE
CB70:           211 *
CB70:           212 * VALUES IN -FL- REGISTERS CONVERTED
CB70:           213 * TO SCALED VALUES IN TEM- REGISTERS
CB70:           214 *
CB70:           215 ********************
CB70: AC F8 07  216 SCALE     LDY   MSLOT
CB73: B9 B8 04  217           LDA   SCALL,Y
CB76: 8D A3 02  218           STA   DIVL
CB79: B9 38 05  219           LDA   SCALH,Y
CB7C: 8D A4 02  220           STA   DIVH
CB7F: B9 B8 05  221           LDA   OFFXL,Y
CB82: 8D A1 02  222           STA   OREGL
CB85: B9 38 06  223           LDA   OFFXH,Y
CB88: 8D A2 02  224           STA   OREGH
CB8B: AD 81 02  225           LDA   XFLL
CB8E: AE 82 02  226           LDX   XFLH
CB91: 20 C2 CA  227           JSR   OFFDIV
CB94: AC F8 07  228           LDY   MSLOT
CB97: AD 87 02  229           LDA   TEMYL
CB9A: 8D 85 02  230           STA   TEMXL
CB9D: AD 88 02  231           LDA   TEMY
CBA0: 8D 86 02  232           STA   TEMX
CBA3: B9 B8 06  233           LDA   OFFYL,Y
CBA6: 8D A1 02  234           STA   OREGL
CBA9: B9 38 07  235           LDA   OFFYH,Y
CBAC: 8D A2 02  236           STA   OREGH
CBAF: AD 93 02  237           LDA   YFLL
CBB2: AE 84 02  238           LDX   YFLH
CBB5: 20 C2 CA  239           JSR   OFFDIV
CBB8: 60        240           RTS
CBB9:           242 ********************
CBB9:           243 *
CBB9:           244 *
CBB9:           245 * TRIPLE READ OF BITPAD
CBB9:           246 * IF OFFSCALE THEN A 1 IS
CBB9:           247 * PUT IN THE HIGH NIBBLE OF
CBB9:           248 * TEM
CBB9:           249 *
CBB9:           250 *
CBB9:           251 ********************
CBB9: 20 F4 CB  252 MREAD     JSR   MIREAD
CBBC: 90 12     253           BCC   SWCHK
CBBE: 2C 00 C0  254           BIT   KBD
CBC1: 30 03     255           BMI   OFFS1
CBC3: 4C B9 CB  256           JMP   MREAD
CBC6: 48        257 OFFS1     PHA
CBC7: AD 80 02  258           LDA   TEM
CBCA: 09 08     259           ORA   #$08
CBCC: 8D 80 02  260           STA   TEM
CBCF: 68        261           PLA
CBD0: 48        262 SWCHK     PHA
CBD1: 4D 80 02  263           EOR   TEM
CBD4: 6A        264           ROR   A
CBD5: 90 05     265           BCC   NOSWITCH
CBD7: A9 50     266           LDA   #$50
CBD9: 20 A1 CC  267           JSR   GWAIT
CBDC: 68        268 NOSWITCH  PLA
CBDD: 6A        269           ROR   A
CBDE: AD 80 02  270           LDA   TEM
CBE1: 2A        271           ROL   A
CBE2: 29 13     272           AND   #$13
CBE4: 8D 80 02  273           STA   TEM
CBE7: 4E 84 02  274           LSR   YFLH
CBEA: 6E 83 02  275           ROR   YFLL
CBED: 4E 82 02  276           LSR   XFLH
CBF0: 6E 81 02  277           ROR   XFLL
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CBF3: 60          278              RTS
CBF4: AD F8 07    279 M1READ       LDA   MSLOT
CBF7: 0A          280              ASL   A
CBF8: 0A          281              ASL   A
CBF9: 0A          282              ASL   A
CBFA: 0A          283              ASL   A
CBFB: AA          284              TAX
CBFC: A0 03       285              LDY   #$3
CBFE: D0 0C       286              BNE   C4SKP
CC00:             287              ORG   $400+OTHROM
CC00: 18          288              CLC                    ;$C400 SPACE ENTRY
CC01: B0          289              DFB   $B0
CC02: 38          290              SEC
CC03: B8          291              CLV
CC04: 08          292              PHP
CC05: 78          293              SEI
CC06: 2C FF CF    294              BIT   ROMSW
CC09: 20 00 C8    295              JSR   OTHROM
CC0C: A9 00       296 C4SKP        LDA   #$0
CC0E: 99 81 02    297 ZDLOOP       STA   XFLL,Y
CC11: 88          298              DEY
CC12: 10 FA       299              BPL   ZDLOOP
CC14: A0 06       300              LDY   #$6
CC16: 8C 78 06    301              STY   HNDX
CC19: 20 83 CC    302 RDLOOP       JSR   RESLP
CC1C: BD 81 C0    303              LDA   DEV0,X
CC1F: 20 42 CC    304              JSR   READTAB
CC22: B0 1D       305              BCS   OFFSC
CC24: A0 02       306              LDY   #$2
CC26: 20 8E CC    307              JSR   AMOVE
CC29: 20 83 CC    308              JSR   RESLP
CC2C: BD 80 C0    309              LDA   DEV1,X
CC2F: 20 42 CC    310              JSR   READTAB
CC32: B0 0D       311              BCS   OFFSC
CC34: 48          312              PHA
CC35: A0 00       313              LDY   #$0
CC37: 20 8E CC    314              JSR   AMOVE
CC3A: 68          315              PLA
CC3B: CE 78 06    316              DEC   HNDX
CC3E: D0 D9       317              BNE   RDLOOP
CC40: 18          318              CLC
CC41: 60          319 OFFSC        RTS
CC42: A9 12       320 READTAB      LDA   #$12
CC44: E9 01       321 ALOOP        SBC   #$1
CC46: D0 FC       322              BNE   ALOOP
CC48: BD 82 C0    323              LDA   DEV3,X
CC4B: 0A          324              ASL   A
CC4C: 0A          325              ASL   A
CC4D: 0A          326              ASL   A
CC4E: 0A          327              ASL   A
CC4F: 49 70       328              EOR   #$70
CC51: 29 F0       329              AND   #$F0
CC53: 8D 87 02    330              STA   TEMYL
CC56: BD 83 C0    331              LDA   DEV2,X
CC59: 8D 88 02    332              STA   TEMY
CC5C: A9 60       333              LDA   #$60
CC5E: E9 01       334 A1LOOP       SBC   #$1
CC60: D0 FC       335              BNE   A1LOOP
CC62: A0 04       336              LDY   #$4
CC64: 4E 88 02    337 DLOOP        LSR   TEMY
CC67: 6E 87 02    338              ROR   TEMYL
CC6A: 88          339              DEY
CC6B: D0 F7       340              BNE   DLOOP
CC6D: AD 88 02    341              LDA   TEMY
CC70: D0 07       342              BNE   ATST
CC72: A9 60       343              LDA   #$60
CC74: CD 87 02    344              CMP   TEMYL
CC77: 90 02       345              BCC   BTST
CC79: C9 0A       346 ATST         CMP   #$0A
CC7B: BD 82 C0    347 BTST         LDA   DEV3,X
CC7E: 49 01       348              EOR   #$1
CC80: 29 01       349              AND   #$1
CC82: 60          350              RTS
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```
CC83 AD F8 07   351 RESLP    LDA   MSLOT
CC86 48         352          PHA
CC87 A9 03      353          LDA#$3
CC89 48         354          PHA
CC8A 2C 41 CC   355          BIT   OFFSC
CC8D 60         356          RTS
CC8E AD 87 02   357 AMOVE    LDA   TEMYL
CC91 79 81 02   358          ADC   XFLL,Y
CC94 99 81 02   359          STA   XFLL,Y
CC97 AD 88 02   360          LDA   TEMY
CC9A 79 82 02   361          ADC   XFLH,Y
CC9D 99 82 02   362          STA   XFLH,Y
CCA0 60         363          RTS
CCA1 38         364 CWAIT    SEC
CCA2 48         365 C2WAIT   PHA
CCA3 E9 01      366 C3WAIT   SBC   #$1
CCA5 D0 FC      367          BNE   C3WAIT
CCA7 68         368          PLA
CCA8 E9 01      369          SBC   #$1
CCAA D0 F6      370          BNE   C2WAIT
CCAC 60         371          RTS
CCAD            373 ************************
CCAD:           374 *
CCAD:           375 * CHARACTER ENTRY SEQUENCE
CCAD:           376 *
CCAD:           377 * CHARACTER STRING ANALYSIS
CCAD:           378 * S... NNNN  SET SCALE FACTOR TO NNNN
CCAD:           379 * X... NNNN  SET X OFFSET TO NNNN
CCAD:           380 * Y... NNNN  SET Y OFFSET TO NNNN
CCAD:           381 * M... (1 OR 2) SET MIXED HIRES MODE
CCAD            382 * H... (1 OR 2) SET HIRES MODE
CCAD:           383 * G... (1 OR 2) SET MIXED LORES MODE
CCAD:           384 * L... (1 OR 2) SET LORES MODE
CCAD:           385 * T... (1 OR 2) SET TEXT MODE
CCAD            386 * N...  SUPRESS ALL PRINTING
CCAD:           387 * D...  RESTORE DEFAULT PARAMETERS
CCAD:           388 * C... NO CURSOR
CCAD:           389 * F... DATA RETURNED UNSCALED
CCAD:           390 * R... DATA RETURNED SCALED
CCAD:           391 * P... STREAM MODE ON
CCAD.           392 * Q... STREAM MODE OFF(DEFAULT)
CCAD.           393 * A... OFFSET AFTER SCALE
CCAD            394 * B... OFFSET BEFORE SCALE(DEFAULT)
CCAD:           395 *
CCAD:           396 ************************
CCAD:28         397 SYNTAX   PLP                 ;TEST IF THIS IS THE FIRST CHAR
CCAE:B0 0C      398          BCS   SYNT1         ;IF NOT THEN SKIP SET-UP
CCB0:A9 00      399          LDA   #$0
CCB2:8D 98 02   400          STA   INX             ;SET INDEX BUFFER TO ZERO
CCB5:8D 99 02   401          STA   NFLAG         ;CLEAR BUFFER STATUS
CCB8:A9 02      402          LDA   #$2             ;MOVE ENTRY POINTER
CCBA:85 36      403          STA   COUTL
CCBC:AD F8 06   404 SYNT1    LDA   CHAR          ;LOAD THE ENTRY CHAR
CCBF:C9 AD      405          CMP   #$AD            ;TEST FOR MINUS
CCC1:D0 03      406          BNE   SYNT2         ;BRANCH IF NOT
CCC3:8D A0 02   407          STA   MIFLAG        ;SET TO NOT ZERO
CCC6:C9 A0      408 SYNT2    CMP   #$A0          ;TEST FOR SPACE
CCC8:F0 29      409          BEQ   EXIT4           ;LEAVE IF SPACE
CCCA:C9 AC      410          CMP   #$AC            ;TEST FOR COMMA
CCCC:F0 28      411          BEQ   PROC1           ;IF SO - ANALYSE STRING
CCCE:C9 8D      412          CMP   #$8D            ;TEST FOR CR
CCD0:F0 26      413          BEQ   PROC2           ;IF SO - ANALYSE STRING
CCD2:08         414          PHP                       ;SAVE STATUS
CCD3:AE 98 02   415          LDX   INX             ;BUFFER INDEX TO X-REG
CCD6:F0 0C      416          BEQ   CHOUT           ;ASSUME ON ALPHA CHAR IF FIRST
CCD8:49 B0      417          EOR   #$B0            ;TEST FOR NUMERIC
CCDA:C9 0A      418          CMP   #$A
CCDC:90 06      419          BCC   CHOUT         ;IF SO THEN BRANCH
CCDE:E0 01      420          CPX   #$1             ;ITS OK TO GET HERE ONLY
CCE0:F0 10      421          BEQ   EXIT3         ;IF ONE ALPHA HAS BEEN STORED
CCE2:D0 6C      422          BNE   ERR1
CCE4:E0 06      423 CHOUT    CPX   #$6           ;ITS AN ERROR IF THERE ARE
CCE6:B0 68      424          BCS   ERR1            ;ALREADY 5 CHARS IN THE BUFFER
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CCE8:AD F8 06   425          LDA   CHAR
CCEB:9D 90 02   426          STA   INA,X        ;SAVE THE CHAR IN THE BUFFER
CCEE:E8         427          INX                ;UPDATE THE BUFFER INDEX
CCEF:8E 98 02   428          STX   INX
CCF2:28         429 EXIT3    PLP                ;RESTORE STATUS
CCF3:4C 86 C8   430 EXIT4    JMP   EXIT         ;GOTO EXIT
CCF6:38         431 PROC1    SEC                ;SET CARRY IF A COMMA
CCF7:90         432          DFB   $90          ;BCS ALWAYS
CCF8:18         433 PROC2    CLC                ;CLEAR CARRY IF A CR
CCF9:08         434          PHP                ;SAVE THE CARRY
CCFA:AD 90 02   435          LDA   INA
CCFD:4C 0C CD   436          JMP   C8SKP
CD00:           437          ORG   $500+OTHROM
CD00:18         438          CLC                ;$C500 SPACE ENTRY
CD01:B0         439          DFB   $B0
CD02:38         440          SEC
CD03:B8         441          CLV
CD04:08         442          PHP
CD05:78         443          SEI
CD06:2C FF CF   444          BIT   ROMSW
CD09:20 00 C8   445          JSR   OTHROM
CD0C:A0 12      446 C8SKP    LDY   #$12
CD0E:88         447 ALPH1    DEY
CD0F:F0 3F      448          BEQ   ERR1
CD11:D9 5C CE   449          CMP   TABL-1,Y
CD14:D0 F8      450          BNE   ALPH1
CD16:A9 CD      451          LDA   #<ROUTIN
CD18:48         452          PHA
CD19:B9 6D CE   453          LDA   ADR-1,Y
CD1C:48         454          PHA
CD1D:B9 7E CE   455          LDA   PARAM-1,Y
CD20:AC 98 02   456          LDY   INX
CD23:60         457          RTS                ;JUMP TO ROUTINE WITH RTS
CD24:C0 01      458 ROUTIN   CPY   #$1
CD26:D0 28      459          BNE   ERR1
CD28:C9 CE      460          CMP   #$CE
CD2A:D0 05      461          BNE   ROUT1
CD2C:8D 99 02   462          STA   NFLAG
CD2F:F0 18      463          BEQ   EXIT5
CD31:AE FB 07   464 ROUT1    LDX   MSLOT
CD34:C9 C4      465          CMP   #$C4
CD36:D0 05      466          BNE   ROUT2
CD38:20 90 CE   467          JSR   DEFAULT
CD3B:D0 0F      468          BNE   EXIT5
CD3D:1E B8 03   469 ROUT2    ASL   PAGE,X
CD40:48         470          PHA
CD41:68         471          PLA
CD42:F0 04      472          BEQ   NOCRS
CD44:0A         473          ASL   A
CD45:BD B8 03   474          LDA   PAGE,X
CD48:6A         475 NOCRS    ROR   A
CD49:9D B8 03   476          STA   PAGE,X
CD4C:4C 0C CE   477 EXIT5    JMP   EXIT1
CD4F:68         478 ERR3     PLA
CD50:20 93 FE   479 ERR1     JSR   SETVID
CD53:A0 19      480 EMSG     LDY   #$19
CD55:B9 43 CE   481 EMSG1    LDA   STRIN-1,Y
CD58:20 ED FD   482          JSR   COUT
CD5B:88         483          DEY
CD5C:D0 F7      484          BNE   EMSG1
CD5E:AD 91 C0   485          LDA   STEXT
CD61:AD 54 C0   486          LDA   SPAG1
CD64:4C 0C CE   487          JMP   EXIT1
CD67:C0 02      488 ARGUT    CPY   #$2
CD69:D0 E5      489          BNE   ERR1
CD6B:48         490          PHA
CD6C:AD 91 02   491          LDA   INA+1
CD6F:49 B0      492          EOR   #$B0
CD71:F0 DC      493          BEQ   ERR3
CD73:C9 03      494          CMP   #$3
CD75:B0 D8      495          BCS   ERR3
CD77:6A         496          ROR   A
CD78:68         497          PLA
```

```
CD79: B0 01      498          BCS   NOROL
CD7B: 2A         499          ROL   A
CD7C: AE F8 07   500 NOROL    LDX   MSLOT
CD7F: 1E B8 03   501          ASL   PAGE,X
CD82: 6A         502          ROR   A
CD83: 20 BE CE   503          JSR   STMODE
CD86: 4C 0C CE   504          JMP   EXIT1
CD89: 85 2B      505 BROUT    STA   HBASH
CD8B: A9 B8      506          LDA   #$B8
CD8D: 85 2A      507          STA   HBASL
CD8F: 88         508          DEY
CD90: B9 90 02   509 DIGLP    LDA   INA,Y
CD93: 49 B0      510          EOR   #$B0
CD95: C9 0A      511          CMP   #$A
CD97: B0 B7      512          BCS   ERR1
CD99: 99 90 02   513          STA   INA,Y
CD9C: 88         514          DEY
CD9D: D0 F1      515          BNE   DIGLP
CD9F: A2 00      516          LDX   #$0
CDA1: C8         517          INY
CDA2: 8D 78 05   518 DIG2     STA   TEMPL
CDA5: 8E F8 05   519          STX   TEMPH
CDA8: C8         520          INY
CDA9: CC 98 02   521          CPY   INX
CDAC: F0 1D      522          BEQ   DIG3
CDAE: A9 0A      523          LDA   #$A
CDB0: 8D A5 02   524          STA   COUNT
CDB3: A2 00      525          LDX   #$0
CDB5: B9 90 02   526          LDA   INA,Y
CDB8: 6D 78 05   527 DIG1     ADC   TEMPL
CDBB: 48         528          PHA
CDBC: 8A         529          TXA
CDBD: 6D F8 05   530          ADC   TEMPH
CDC0: 30 BE      531          BMI   ERR1
CDC2: AA         532          TAX
CDC3: 68         533          PLA
CDC4: CE A5 02   534          DEC   COUNT
CDC7: D0 EF      535          BNE   DIG1
CDC9: F0 D7      536          BEQ   DIG2
CDCB: A4 2B      537 DIG3     LDY   HBASH
CDCD: C0 04      538          CPY   #$4
CDCF: F0 08      539          BEQ   DIG4
CDD1: AC A0 02   540          LDY   MIFLAG
CDD4: F0 03      541          BEQDIG4
CDD6: 20 58 CB   542          JSR   TWOCOM
CDD9: AC F8 07   543 DIG4     LDY   MSLOT
CDDC: 91 2A      544          STA   (HBASL),Y
CDDE: A9 38      545          LDA   #$38
CDE0: 85 2A      546          STA   HBASL
CDE2: E6 2B      547          INC   HBASH
CDE4: 8A         548          TXA
CDE5: 91 2A      549          STA   (HBASL),Y
CDE7: 4C 0C CE   550          JMP   EXIT1
CDEA: AC F8 07   551 CROUT    LDY   MSLOT
CDED: 48         552          PHA
CDEE: 6A         553          ROR   A
CDEF: 68         554          PLA
CDF0: 90 05      555          BCC   CROUT2
CDF2: 39 38 04   556          AND   MPAGE,Y
CDF5: B0 03      557          BCS   CROUT3
CDF7: 19 38 04   558 CROUT2   ORA   MPAGE,Y
CDFA: 99 38 04   559 CROUT3   STA   MPAGE,Y
CDFD: 4C 0C CE   560          JMP   EXIT1
CE00             561          ORG   $600+OTHROM
CE00: 18         562          CLC                    ;$C600 SPACE ENTRY
CE01: B0         563          DFB   #$B0
CE02: 38         564          SEC
CE03: B8         565          CLV
CE04: 08         566          PHP
CE05: 78         567          SEI
CE06: 2C FF CF   568          BIT   ROMSW
CE09: 20 00 C8   569          JSR   OTHROM
CE0C: A9 00      570 EXIT1    LDA   #$0
```

```
CE0E: 8D A0 02   571            STA   MIFLAG
CE11: 8D 98 02   572            STA   INX
CE14: AC F8 07   573            LDY   MSLOT
CE17: B9 38 04   574            LDA   MPAGE,Y
CE1A: 29 C0      575            AND   #$C0
CE1C: 99 38 04   576            STA   MPAGE,Y
CE1F: B9 B8 03   577            LDA   PAGE,Y
CE22: 29 3F      578            AND   #$3F
CE24: 49 25      579            EOR   #$25
CE26: 19 38 04   580            ORA   MPAGE,Y
CE29: 99 38 04   581            STA   MPAGE,Y
CE2C: 28         582            PLP
CE2D: B0 12      583            BCS   EXIT2
CE2F: AD 99 02   584            LDA   NFLAG
CE32: F0 0A      585            BEQ   PRINT
CE34: A9 58      586            LDA   #IORTS
CE36: 85 36      587            STA   COUTL
CE38: A9 FF      588            LDA   #IORTS/256
CE3A: 85 37      589            STA   COUTH
CE3C: D0 03      590            BNE   EXIT2
CE3E: 20 93 FE   591 PRINT      JSR   SETVID
CE41: 4C 86 C8   592 EXIT2      JMP   EXIT
CE44: 8D         593 STRIN      DFB   $8D
CE45: D2 CF D2   594            ASC   "RORRE       XATNYS TELBAT +++"
CE48: D2 C5 A0
CE4B: D8 C1 D4
CE4E: CE D9 D3
CE51: A0 D4 C5
CE54: CC C2 C1
CE57: D4 A0 AA
CE5A: AA AA 87
CE5D: D0 D1 C1   595 TABL       ASC   "PQABSXYTMHLGCFRND"
CE60: C2 D3 D8
CE63: D9 D4 CD
CE66: C8 CC C7
CE69: C3 C6 D2
CE6C: CE C4
CE6E: E9         596 ADR        DFB   CROUT-1
CE6F: E9         597            DFB   CROUT-1
CE70: E9         598            DFB   CROUT-1
CE71: E9         599            DFB   CROUT-1
CE72: 88         600            DFB   BROUT-1
CE73: 88         601            DFB   BROUT-1
CE74: 88         602            DFB   BROUT-1
CE75: 66         603            DFB   AROUT-1
CE76: 66         604            DFB   AROUT-1
CE77: 66         605            DFB   AROUT-1
CE78: 66         606            DFB   AROUT-1
CE79: 66         607            DFB   AROUT-1
CE7A: 23         608            DFB   ROUTIN-1
CE7B: 23         609            DFB   ROUTIN-1
CE7C: 23         610            DFB   ROUTIN-1
CE7D: 23         611            DFB   ROUTIN-1
CE7E: 23         612            DFB   ROUTIN-1
CE7F: 80         613 PARAM      DFB   $80
CE80: 7F         614            DFB   $7F
CE81: 40         615            DFB   $40
CE82: BF         616            DFB   $BF
CE83: 04         617            DFB   $04
CE84: 05         618            DFB   $05
CE85: 06         619            DFB   $06
CE86: 08         620            DFB   $08
CE87: 48         621            DFB   $48
CE88: 40         622            DFB   $40
CE89: 02         623            DFB   $02
CE8A: 0A         624            DFB   $0A
CE8B: 00         625            DFB   $0
CE8C: 01         626            DFB   $01
CE8D: 80         627            DFB   $80
CE8E: CE         628            DFB   $CE
CE8F: C4         629            DFB   $C4
```

```
CE90                631 **********************
CE90                632 **********************
CE90                633 *
CE90                634 * DEFAULT
CE90                635 *
CE90                636 * SCALE = 16
CE90                637 * X OFFSET = 1536
CE90                638 * Y OFFSET = 1536
CE90                639 * HIRES PAGE 2
CE90.               640 * PRINT ON
CE90                641 * CURSOR ON
CE90                642 * STREAM MODE OFF
CE90:               643 * DATA RETURNED UNSCALED
CE90:               644 * OFFSET BEFORE SCALE
CE90:               645 *
CE90:               646 **********************
CE90:               647 **********************
CE90: A9 10         648 DEFAULT   LDA   #$10
CE92: 9D 88 04      649           STA   SCALL,X
CE95: A9 00         650           LDA   #$0
CE97: 9D 38 05      651           STA   SCALH,X       ;SET SCALE FOR 16
CE9A 9D 88 05       652           STA   OFFXL,X
CE9D: 9D 88 06      653           STA   OFFYL,X       ;SET X OFFSET TO 1536
CEA0: 8D 98 02      654           STA   INX
CEA3: A9 03         655           LDA   #$3
CEA5: 8D 80 02      656           STA   TEM
CEA8 A9 06          657           LDA   #$6           ;SET Y OFFSET TO 1536
CEAA: 9D 38 06      658           STA   OFFXH,X
CEAD: 9D 38 07      659           STA   OFFYH,X
CEB0: 2C 10 C0      660           BIT   KBDSTRB
CEB3: 20 F4 CB      661           JSR   MIREAD
CEB6: 20 D0 CB      662           JSR   SWCHK
CEB9: AE F8 07      663           LDX   MSLOT
CEBC: A9 40         664           LDA   #$40          ;SET PAGE FOR HIRES P2
CEBE: A8            665 STMODE    TAY
CEBF: 8D 52 C0      666           STA   SNMIX
CEC2: 8D 57 C0      667           STA   SHIRES
CEC5: 8D 51 C0      668           STA   STEXT
CEC8: 8D 54 C0      669           STA   SPAG1
CECB: 29 0C         670           AND   #$0C
CECD: F0 03         671           BEQ   DEF1
CECF: 8D 53 C0      672           STA   SMIX
CED2: 98            673 DEF1      TYA
CED3: 29 63         674           AND   #$63
CED5: F0 03         675           BEQ   DEF2
CED7: AD 50 C0      676           LDA   SGR
CEDA. 98            677 DEF2      TYA
CED8: 29 4A         678           AND   #$4A
CEDD: F0 03         679           BEQ   DEF3
CEDF: AD 55 C0      680           LDA   SPAG2
CEE2: 98            681 DEF3      TYA
CEE3: 29 03         682           AND   #$03
CEE5: F0 03         683           BEQ   DEF4
CEE7: 8D 56 C0      684           STA   SLORES
CEEA: 98            685 DEF4      TYA
CEEB: 9D 88 03      686           STA   PAGE,X        ;AND FOR FULL SCALE OUTPUT
CEEE: 29 3F         687           AND   #$3F
CEF0: 49 25         688           EOR   #$25
CEF2: 9D 38 04      689           STA   MPAGE,X
CEF5: 60            690           RTS
CEF6:               691 **********************
CEF6:               692 *
CEF6:               693 * JUMP TABLE
CEF6                694 *
CEF6:               695 **********************
CEF6.               696           ORG   $6F6+OTHROM
CEF6 4C 4C CA       697 JWINCHK   JMP   WINCHK
CEF9: 4C 89 CB      698 JMREAD    JMP   MREAD
CEFC: 4C 70 CB      699 JSCALE    JMP   SCALE

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

```
CC8E AILOOP     CE6E ADR        CD0E ALPH1      CC8E AMOVE
C809 AUTOHROM   CD67 AROUT      C983 A          CC44 ALOOP
C800 ASCIEX     C8C6 ASCEX      CA6A ASCON      CA89 ASKIP
CC74 AT&T       C9C4 B          C9F0 BASCLC       28 BASL
CD89 BNOXT      CAA0 BSKIP      CC78 BTST       02A9 C1HAR
C90C C1SKP      CA0C C2SKP      CC0C C4SKP      CD0C C5SKP
?C918 CALLCURS  CCE4 CHOUT        24 CH         06F8 CHAR
CA19 CLOOP      02A5 COUNT      FDED COUT         37 COUTH
   36 COUTL     CDF7 CROUT2     CDFA CROUT3     C8F0 CURSOUT
C9AD C          CDEA CROUT      CA82 CSKIP      C9D8 CTRCHK
C985 CTRLOOP    CED2 DEF1       CEDA DEF2       CEE2 DEF3
CEEA DEF4       CE90 DEFAULT    C081 DEV0     ?C82D DEXIT
C083 DEV2       C082 DEV3       CDC8 DIG3       CDD9 DIG4
CDA2 DIG2       02A3 DIVL       02A4 DIVH       CA8D DSKIP
CD55 EMSG1    ?CD53 EMSG        C86D END        C83F EPOINT
CD50 ERR1       CD4F ERR3       CE0C EXIT1      CCF2 EXIT3
CD4C EXIT5      C886 EXIT       CE41 EXIT2      CCF3 EXIT4
C82C FEXIT      CA86 FLOOP      CCA2 G2WAIT     CCA3 G3WAIT
C890 GLOOP      C951 GR         CCA1 GWAIT        29 HBASH
   2A HBASL     C971 HIRES      CA9D HLOOP      0678 HNDX
CA2B HPOSN1     CA2C HPOSN2     0200 IN0        0201 IN1
0202 IN2        0203 IN3        0290 INA      C86F INEX1
C883 INEX2      C88C INEXIT   ?C900 INPUTXY    0298 INX
FF58 IORTS      CAAF JLOOP    ?CEF9 JMREAD    ?CEFC JSCALE
?CEF6 JWINCHK   C000 KBD        C010 KBDSTRB    CA8A KLOOP
C9DE LOCLC      C980 LOOP       CAD7 LOOP1      CAF3 LOOP2
C80C LOOP3    ?CB1F LOOP4       C962 LOR1     ?C95A LORES
C8F4 MIREAD     02A0 MIFLAG   ?C930 MIX       0438 MPAGE
C089 MREAD      07F8 MSLOT      0299 NFLAG      CA67 NO
CD48 NOCRS      C834 NOPR       CD7C NOROL      C8DC NOSWITCH
CAC2 OFFDIV     C8C6 OFFS1      CC41 OFFSC      C864 OFFSET
0638 OFFXH      0588 OFFXL      0738 OFFYH      0688 OFFYL
02A2 OREGH      02A1 OREGL      C800 OTHROM     C94E OUT1
C99E OUTSIDE    C9D0 OUT        0388 PAGE       CE7F PARAM
?C902 POINT     CA80 PGBIT      CAF2 POS        C82D PRCHK
CE3E PRINT      CCF6 PROC1      CCF8 PROC2      CC19 RDLOOP
CC42 READTAB    0288 REGH       0287 REGL       CCB3 REBLP
CFFF ROMSW      CD31 ROUT1      CD3D ROUT2      CD24 ROUTIN
?CAC1 RTN       0298 SAVSLOT    C870 SCALE      0538 SCALH
0488 SCALL      FE93 SETVID     C050 SGR        C057 SHIRES
C056 SLORES     C053 SMIX       C052 SNMIX      C054 SPAG1
C055 SPAG2      C051 STEXT      CEBE STMODE     CE44 STRIN
C8D0 SWCHK      CCBC SYNT1      CCC6 SYNT2      CCAD SYNTAX
CE9D TABL       05F8 TEMPH      0578 TEMPL      0285 TEMXL
0286 TEMX       0287 TEMYL      0288 TEMY       0280 TEM
C936 TEXT       CB98 TWOCOM     CA4C WINCHK     0282 XFLH
0281 XFLL       CA5F YES        0284 YFLH       0283 YFLL
CC0E ZDLOOP
```

```
   24 CH           28 BASL         2A HBASL        28 HBASH
   36 COUTL        37 COUTH      0200 IN0        0201 IN1
0202 IN2        0203 IN3        0280 TEM        0281 XFLL
0282 XFLH       0283 YFLL       0284 YFLH       0285 TEMXL
0286 TEMX       0287 TEMYL      0287 REGL       0288 TEMY
0289 REGH       0290 INA        0298 INX        0299 NFLAG
0298 SAVSLOT    02A0 MIFLAG     02A1 OREGL      02A2 OREGH
02A3 DIVL       02A4 DIVH       02A5 C1HAR      02A9 COUNT
0388 PAGE       0438 MPAGE      0488 SCALL      0538 SCALH
0578 TEMPL      0588 OFFXL      05F8 TEMPH      0638 OFFXH
0678 HNDX       0688 OFFYL      06F8 CHAR       0738 OFFYH
07F8 MSLOT      C000 KBD        C010 KBDSTRB    C050 SGR
C051 STEXT      C052 SNMIX      C053 SMIX       C054 SPAG1
C055 SPAG2      C056 SLORES     C057 SHIRES     C080 DEV1
C081 DEV0       C082 DEV3       C083 DEV2       C800 OTHROM
C809 AOTHROM    C82D PRCHK      C834 NOPR       C83F EPOINT
C868 E1PNT      C86D END        C86F INEX1      C883 INEX2
C886 EXIT       C88C INEXIT     C890 GLOOP      C8C6 ASCEX
C8D0 ASC1EX     C8F0 CURSOUT  ?C900 INPUTXY   ?C902 POINT
C90C C1SKP    ?C918 CALLCURS  ?C930 MIX       C936 TEXT
C94E OUT1       C951 GR       ?C95A LORES     C962 LOR1
C971 HIRES      C980 LOOP       C985 CTRLOOP    C99E OUTSIDE
C9AD C          C983 A          C9C4 B          C9D0 OUT
```

```
C9D8 CTRCHK     C9DE LOCLC      C9F0 BASCLC     CA0C C2SKP
CA28 HPOSN1     CA2C HPOSN2     CA39 CLOOP      CA4C WINCHK
CA5F YES        CA67 NO         CA6A ASCON      CA80 POSIT
CA86 FLOOP      CA89 ASKIP      CA9D HLOOP      CAA0 BSKIP
CAAF JLOOP      CAB2 CSKIP      CABA KLOOP      CABD DSKIP
?CAC1 RTN       CAC2 OFFDIV     CAD1 DIVIDE     CAD7 LOOP1
CAF2 POS        CAF3 LOOP2      CB0C LOOP3      ?CB1F LOOP4
CB2C FEXIT      ?CB2D DEXIT     CB3F EEXIT      CB57 EIEXIT
CB58 TWOCOM     CB64 OFFSET     CB70 SCALE      CBB9 MREAD
CBC6 OFFS1      CBDO BWCHK      CBDC NOSWITCH   CBF4 M1READ
CC0C C4SKP      CC0E ZDLOOP     CC19 RDLOOP     CC41 OFFSC
CC42 READTAB    CC44 ALOOP      CC5E A1LOOP     CC64 DLOOP
CC79 ATST       CC7B BTST       CC83 RESLP      CC8E AMOVE
CCA1 GWAIT      CCA2 G2WAIT     CCA3 G3WAIT     CCAD SYNTAX
CCBC SYNT1      CCC6 SYNT2      CCE4 CHOUT      CCF2 EXIT3
CCF3 EXIT4      CCF6 PROC1      CCF8 PROC2      CD0C C5SKP
CD0E ALPH1      CD24 ROUTIN     CD31 ROUT1      CD3D ROUT2
CD48 NOCRS      CD4C EXIT5      CD4F ERR3       CD50 ERR1
?CD53 EMSG      CD55 EMSG1      CD67 AROUT      CD7C NOROL
CD89 SROUT      CD90 DIGLP      CDA2 DIG2       CDB8 DIG1
CDC8 DIG3       CDD9 DIG4       CDEA CROUT      CDF7 CROUT2
CDFA CROUT3     CE0C EXIT1      CE3E PRINT      CE41 EXIT2
CE44 STRIN      CE5D TABL       CE6E ADR        CE7F PARAM
CE90 DEFAULT    CEBE STMODE     CED2 DEF1       CEDA DEF2
CEE2 DEF3       CEEA DEF4       ?CEF6 JWINCHK   ?CEF9 JMREAD
?CEFC JSCALE    CFFF ROMSW      FDED COUT       FE93 SETVID
FF58 IORTS
```

```
0000                    1               PAGE
0000                    2 ********************************
0000                    3 *
0000                    4 * COPYRIGHT 1979
0000                    5 *
0000                    6 * APPLE COMPUTER INC.
0000                    7 *
0000                    8 * CUPERTINO CALIFORNIA
0000                    9 *
0000                   10 * ALL RIGHTS RESERVED
0000                   11 *
0000                   12 ********************************
0000                   13 * WRITTEN JAN 1979
0000                   14 * BY JOHN A.
0000                   15 * APPLE COMPUTER
0000                   16 * SYSTEMS SOFTWARE
0000                   17 ********************************
0000                   18 * WINDOCK CORRECTED APR 25,1979
0000                   19 *    BY JOHN A.
0000                   20               PAGE
0000                   21 ************************
0000                   22 *                      *
0000                   23 * BITPAD TO APPLESOFTII *
0000                   24 * INTERFACE ROUTINE    *
0000                   25 *  THIS ROUTINE MAKES  *
0000                   26 * IT POSSIBLE TO CALL  *
0000                   27 * THE BITPAD AT HIGH   *
0000                   28 * SPEED AND FETCH THE  *
0000                   29 * POINTS DRAWN ,DIRECTLY*
0000                   30 * INTO APPLESOFT DATA  *
0000                   31 * ARRAYS AT MAXIMUM    *
0000                   32 * SPEED. ARRAYS MUST BE *
0000                   33 * DIMENSIONED BEFORE   *
0000                   34 * CALLING THIS ROUTINE *
0000                   35 * THEY ARE X% AND Y%   *
0000                   36 * IN ADDITION M% AND D% *
0000                   37 * MUST ALSO BE ALLOCATED*
0000                   38 ************************
0C00                   39               ORG $C00
0C00                   40               OBJ $2000
0C00                   41 ********************
0C00                   42 *PAGE ZERO USAGE    *
0C00                   43 VARPNT        EQU $83
0C00                   44 VARNAM        EQU $81
0C00                   45 LOWTR         EQU $9B
0C00                   46 TXTTAB        EQU $67
0C00                   47 VARTAB        EQU $69
0C00                   48 ARYTAB        EQU $6B
0C00                   49 STREND        EQU $6D
0C00                   50 ARYPNT        EQU $94
0C00                   51 *FAC EQU $9D TO A3
0C00                   52 DELTA         EQU $9D
0C00                   53 INDX          EQU $9E
0C00                   54 NADRS         EQU $A0
0C00                   55 MAXN          EQU $A2
0C00                   56 *ARG EQU $A5 TO AB
0C00                   57 TICFLG        EQU $A5
0C00                   58 XVPTR         EQU $A6
0C00                   59 YVPTR         EQU $A8
0C00                   60 TMAXY         EQU $AA                 ;TEMP MAX Y COORD LIMIT
0C00                   61 *    ;TMAXY =MIN(MIXED MODE*160,MAXY)
0C00                   62 XOL           EQU $E0                 ;PRIOR X-COORD SAVE
0C00                   63 XOH           EQU $E1                 ;PRIOR X-COORD SAVE HI
0C00                   64 YO            EQU $E2                 ;PRIOR Y-COORD SAVE
0C00                   65 ERRFLG        EQU $D8
0C00                   66 REMSTK        EQU $F8
0C00                   67 ERRNUM        EQU $DE
0C00                   68 ************************
0C00                   69 *ENTRY POINTS USED    *
```

```
0C00:                  70 HILIN       EQU $F53A          ; REAL HILIN ENTRY
0C00:                  71 HPLOT       EQU $F457          ; REAL HPLOT ENTRY
0C00:                  72 CHRGET      EQU $0081          ; NEXT PGM CHAR
0C00:                  73 CHRGOT      EQU $0087
0C00:                  74 CRDO        EQU $DAFB
0C00:                  75 OUTQST      EQU $DB5A
0C00:                  76 OUTDO       EQU $DB5C
0C00:                  77 ISLETC      EQU $E07D
0C00:                  78 TYPERR      EQU $D42A
0C00:                  79 HNDLERX     EQU $F2EF
0C00:                  80 WAIT        EQU $FCA8          ;MON A WAIT
0C00:                  81             PAGE
0C00:                  82 ************************
0C00:                  83 * DEVICE ADDRESSES
0C00:                  84 SPKR        EQU $C030          ; TOGGLES APPLE SPKR
0C00:                  85 STEXT       EQU $C051          ; SET TEXT MODE!
0C00:                  86 SPAG1       EQU $C054
0C00:                  87 ************************
0C00:                  88 * BITPAD INTERFACE EQU *
0C00:                  89 ************************
0C00:                  90 TEM         EQU $280           ; RETURN FLAG LOC
0C00:                  91 * HI NIBBLE =1 FOR SCALED RESULTS
0C00:                  92 * LO NIBBLE  0=PEN DOWN
0C00:                  93 *     1=PEN LIFT
0C00:                  94 *     2 PEN FALL
0C00:                  95 *     3=PEN UP
0C00:                  96 XFLL        EQU $281           ;X-COORD LO UNSCALED
0C00:                  97 XFLH        EQU $282           ;X-COORD HI UNSCALED
0C00:                  98 YFLL        EQU $283           ;Y-COORD LOW UNSCALED
0C00:                  99 YFLH        EQU $284           ;Y-COORD HI UNSCALED
0C00:                 100 TEMXL       EQU $285           ;X-COORD LO SCALED
0C00:                 101 TEMX        EQU $286           ;X-COORD HI SCALED
0C00:                 102 TEMYL       EQU $287           ;Y-COORD LO SCALED
0C00:                 103 TEMY        EQU $288           ;Y-COORD HI SCALED
0C00:                 104 SSMI        EQU $29A           ;LO INDIRECT ADRS
0C00:                 105 SAVBLOT     EQU $29B
0C00:                 106 RTNCD       EQU $28C           ;=700 BITSOFT RTN CODE
0C00:                 107 PAGE        EQU $3B8           ;+CN : SCREEN MODE
0C00:                 108 * HI BIT=1 MEANS SCALE DATA
0C00:                 109 * 40 = HIRES PG2
0C00:                 110 * 20 = HIRES PG1
0C00:                 111 HIRES1      EQU $20
0C00:                 112 * 08 = TEXT  PG2
0C00:                 113 * 04 = TEXT  PG1
0C00:                 114 * 02 = LORES PG2
0C00:                 115 * 01 = LORES PG1
0C00:                 116 * 42 = HIRES PG2 MIXED
0C00:                 117 * 21 = HIRES PG1 MIXED
0C00:                 118 * 0A = LORES PG2 MIXED
0C00:                 119 * 05 = LORES PG1 MIXED
0C00:                 120 MXYVALU     EQU 160            ; FOR NORMAL APPLE
0C00:                 121 MSLOT       EQU $7F8
0C00:                 122 ************************
0C00:                 123 * BITPAD ENTRY POINTS  *
0C00:                 124 ************************
0C00:                 125 POINT       EQU $C102
0C00:                 126 MREAD       EQU $CEF9
0C00:                 127 WINCHK      EQU $CEF6
0C00:                 128 SCALE       EQU $CEFC
0C00:                 129             PAGE
0C00:                 130 ************************
0C00: 4C 94 0C        131             JMP BITSOFT
0C03: 4C 58 0F        132             JMP FINDVAR        ;FIND VARABLE UTILITY ENTR
0C06: 4C 27 0F        133             JMP FINDARY        ;FIND ARRAY UTILITY ENTRY
0C09:                 134 ************************
0C09:                 135 VNAMTAB     EQU *
0C09: C4 80           136 DLTANAM     DFB $C4,$80        ; D%
0C0B: CE 80           137 NDXNAM      DFB $CE,$80        ; N%
0C0D: D8 80           138 XVNAM       DFB $D8,$80        ; X%
0C0F: D9 80           139 YVNAM       DFB $D9,$80        ; Y%
0C11:                 140 DNAME       EQU DLTANAM-VNAMTAB
0C11:                 141 NNAME       EQU NDXNAM-VNAMTAB
0C11:                 142 XNAME       EQU XVNAM-VNAMTAB
```

```
0C11                    143 YNAME       EQU YVNAM-VNAMTAB
0C11  00                144 MINXL       DFB $00
0C12  00                145 MINX        DFB $00
0C13  18                146 MAXXL       DFB 24
0C14  01                147 MAXX        DFB 1               ;MAX X=256+24
0C15  00                148 MINY        DFB $0
0C16  C0                149 MAXY        DFB 192
0C17  03 4F D0          150 CTABLE      DFB $03,$4F,$D0
0C1A  19 52 C9          151             DFB $19,$52,$C9
0C1D  07 48 D4          152             DFB $07,$48,$D4
0C20  20 41 D0          153             DFB $20,$41,$D0
0C23  10 4C C5          154             DFB $10,$4C,$C5
0C26  20 43 CF          155             DFB $20,$43,$CF
0C29  0D 50 D5          156             DFB $0D,$50,$D5
0C2C  14 45 D2          157             DFB $14,$45,$D2
0C2F  37 79             158             DFB $37,$79
0C31                    159             PAGE
0C31                    160 ****************************
0C31                    161 *  BITPAD MESSAGES
0C31: 20 44 41
0C34: 50 54 49
0C37: C2                162 BITMSG      DCI "               DAPTIB"
0C38: 44 45 4C
0C3B: 54 41 20
0C3E: 53 49 5A
0C41: C5                163 DLTASIZ     DCI "DELTA          SIZE"
0C42: 44 45 4C
0C45: 54 41 20
0C48: 55 4E 44
0C4B: 45 46 49
0C4E: 4E 45 C4          164 DLTADEF     DCI "DELTA          UNDEFINED"
0C51: 49 4E 44
0C54: 45 58 20
0C57: 55 4E 44
0C5A: 45 46 49
0C5D: 4E 45 C4          165 INDXDEF     DCI "INDEX          UNDEFINED"
0C60: 41 52 52
0C63: 41 59 20
0C66: 44 49 4D
0C69: 45 4E 53
0C6C: 49 4F CE          166 ARYDEF      DCI "ARRAY          DIMENSION"
0C6F: 42 41 44
0C72: 20 53 55
0C75: 42 53 43
0C78: 52 49 50
0C7B: D4                167 NGTMAXN     DCI "BAD            SUBSCRIPT"
0C7C: 4E 4F 54
0C7F: 20 49 4E
0C82: 20 53 43
0C85: 41 4C 45
0C88: 44 20 48
0C8B: 49 52 45
0C8E: 53 20 4D
0C91: 4F 44 C5          168 NOTHGR      DCI "NOT            IN SCALED HIRES MODE"
0C94:                   169 XDLTASIZ    EQU DLTASIZ-BITMSG+40 ;THIS BIASES RTN CDS BY
0C94:                   170 XDLTADEF    EQU DLTADEF-BITMSG+40 ;THIS BIASES RTN CDS BY
0C94:                   171 XINDXDEF    EQU INDXDEF-BITMSG+40 ;THIS BIASES RTN CDS BY
0C94:                   172 XARYDEF     EQU ARYDEF-BITMSG+40 ;THIS BIASES RTN CDS BY 4
0C94:                   173 XNRANGE     EQU NGTMAXN-BITMSG+40 ;THIS BIASES RTN CDS BY
0C94:                   174 XNOTHGR     EQU NOTHGR-BITMSG+40 ;THIS BIASES RTN CDS BY 4
0C94:                   175             PAGE
0C94:                   176 ************************
0C94:                   177 *  BEGIN CODE          *
0C94:                   178 ************************
0C94:                   179 BITSOFT     EQU *
0C94: 20 95 0F          180             JSR USRNAMB
0C97: A2 00             181 NONAMES     LDX #DNAME          ;=0
0C99: 20 E4 0E          182             JSR SETNAME         ; SET UP VARNA
0C9C: 20 58 0F          183             JSR FINDVAR         ; GO FIND DELTA
0C9F: B0 33             184             BCS DLTAOK          ;HE DID ALLOCATE IT'
0CA1: A2 39             185             LDX #XDLTADEF
0CA3                    186 BITPERR     EQU *
0CA3: 24 D8             187             BIT ERRFLG          ; IS ON ERR ON?
```

```
0CA5: 10 08       188              BPL DOERR          ; NO
0CA7: 86 DE       189              STX ERRNUM
0CA9: A6 F8       190              LDX RENSTK         ; GET STACK PTR
0CAB: 9A          191              TXS                 ;RESTORE STACK
0CAC: 4C EF F2    192              JMP HNDLERX
0CAF:             193 DOERR        EQU *
0CAF: AD 54 C0    194              LDA SPAG1          ; BACK TO PAGE 1 TOO
0CB2: AD 51 C0    195              LDA STEXT          ; BACK TO TEXT MODE!
0CB5: 20 F8 DA    196              JSR CRDO
0CB8: 20 5A DB    197              JSR OUTGST
0CBB: A0 06       198              LDY #6
0CBD: B9 31 0C    199 BITPD        LDA BITMSG,Y
0CC0: 20 5C DB    200              JSR OUTDO
0CC3: 88          201              DEY
0CC4: 10 F7       202              BPL BITPD
0CC6: BD 09 0C    203 BMSGLP       LDA BITMSG-40,X
0CC9: 48          204              PHA
0CCA: 20 5C DB    205              JSR OUTDO
0CCD: E8          206              INX
0CCE: 68          207              PLA
0CCF: 10 F5       208              BPL BMSGLP         ; LOOP FOR NXT
0CD1: 4C 2A D4    209              JMP TYPERR         ;ADD LINE # & QUIT
0CD4:             210 DLTAOK       EQU *
0CD4: A0 00       211              LDY #0
0CD6: B1 83       212              LDA (VARPNT),Y
0CD8: 84 A5       213              STY TICFLG         ;ASSUME TICK
0CDA: 18          214              CLC                 ; ASSUME NOT NEGATIVE
0CDB: 10 08       215              BPL CHKDVALU
0CDD: 38          216              SEC                 ;SAY NEGATIVE
0CDE: 85 A5       217              STA TICFLG         ;SET NOTICK
0CE0: 49 FF       218              EOR #$FF           ;IS D% < 256
0CE2: F0 04       219              BEQ CHKDVALU       ; IT'S OK
0CE4: A2 2F       220 DSIZERR      LDX #XDLTASIZ
0CE6: D0 BD       221              BNE BITPERR
0CE8:             222 CHKDVALU     EQU *
0CE8: C8          223              INY                 ; Y=1
0CE9: B1 83       224              LDA (VARPNT),Y     ; GET DELTA LOW
0CEB: 90 04       225              BCC NOCOMPL        ;DONT COMPLEMENT
0CED: 49 FF       226              EOR #$FF
0CEF: 69 00       227              ADC #0             ; DO TWOS COMP
0CF1: 30 F1       228 NOCOMPL      BMI DSIZERR        ;!DELTA!>127 ERR
0CF3: F0 EF       229              BEQ DSIZERR
0CF5: 85 9D       230              STA DELTA          ; SAVE WINDOW SIZE
0CF7: A2 02       231              LDX #NNAME         ; =2
0CF9: 20 E4 0E    232              JSR SETNAME        ;
0CFC: 20 58 0F    233              JSR FINDVAR        ; IS NX THERE
0CFF: B0 04       234              BCS NTHERE         ;YES HE DID
0D01:             235              PAGE
0D01: A2 48       236 NDEFERR      LDX #XINDXDEF
0D03: D0 9E       237              BNE BITPERR
0D05:             238 NTHERE       EQU *
0D05: A0 00       239              LDY #0
0D07: B1 83       240              LDA (VARPNT),Y
0D09: 30 35       241              BMI NRNGERR        ; INDX<0 ERR
0D0B: 85 9F       242 IXOK         STA INDX+1         ; SAVE VALUE
0D0D: C8          243              INY                 ;Y=1
0D0E: B1 83       244              LDA (VARPNT),Y
0D10: 85 9E       245              STA INDX
0D12: A5 83       246              LDA VARPNT
0D14: 85 A0       247              STA NADRS          ; SAVE IT ADDRESS
0D16: A5 84       248              LDA VARPNT+1
0D18: 85 A1       249              STA NADRS+1        ; FOR UPDATEING N
0D1A: A2 04       250              LDX #XNAME         ; =4
0D1C: 20 E4 0E    251              JSR SETNAME
0D1F: 20 27 0F    252              JSR FINDARY        ; IS X%(
0D22: D0 05       253              BCS XTHERE         ;YES SMART USER
0D24: A2 57       254 ARYERR       LDX #XARYDEF
0D26: 4C A3 0C    255 ERRJMP       JMP BITPERR
0D29:             256 XTHERE       EQU *
0D29: A0 04       257              LDY #4             ; POINT AT # OF DIMS
0D2B: B1 83       258              LDA (VARPNT),Y     ; IS DIMS 1?
0D2D: C9 01       259              CMP #1             ; IS IT A VECTOR ?
0D2F: D0 F3       260              BNE ARYERR
```

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0D31  C8          261 XDIMSOK   INY                 ; Y=5
0D32  C8          262           INY                 ;Y=6
0D33  38          263           SEC
0D34  B1 83       264           LDA (VARPNT),Y
0D36  E5 9F       265           SBC INDX
0D38  AA          266           TAX                 ;SAVE LOW RESULT
0D39  88          267           DEY                 ;Y=5
0D3A  B1 83       268           LDA (VARPNT),Y
0D3C  E5 9F       269           SBC INDX+1
0D3E  B0 04       270           BCS NGTXROWS
0D40  A2 66       271 NRNGERR   LDX #XNRANGE
0D42  D0 E2       272           BNE ERRJMP
0D44  30 FA       273 NGTXROWS  BMI NRNGERR
0D46  D0 04       274           BNE NISOK
0D48  E0 02       275           CPX #2
0D4A  90 F4       276           BCC NRNGERR
0D4C  B1 83       277 NISOK     LDA (VARPNT),Y      ; GET MAX
0D4E  85 A3       278           STA MAXN+1
0D50  C8          279           INY                 ;Y=6
0D51  B1 83       280           LDA (VARPNT),Y      ; GET LO
0D53  85 A2       281           STA MAXN
0D55  A5 83       282           LDA VARPNT
0D57  18          283           CLC
0D58  69 07       284           ADC #7              ; CALC BASE ADDRESS
0D5A  85 A6       285           STA XVPTR           ; SET X BASE
0D5C  A6 84       286           LDX VARPNT+1        ; GET HI BASE
0D5E  90 01       287           BCC *+3             ; NO CARRY FROM ADD
0D60  E8          288           INX
0D61  86 A7       289           STX XVPTR+1         ; X BASE COMPLETE
0D63              290           PAGE
0D63  A2 06       291           LDX #YNAME          ; =6
0D65  20 E4 0E    292           JSR SETNAME
0D68  20 27 0F    293           JSR FINDARY
0D6B  90 B7       294           BCC ARYERR
0D6D  A0 04       295 YTHERE    LDY #4
0D6F  B1 83       296           LDA (VARPNT),Y
0D71  C9 01       297           CMP #1
0D73  D0 AF       298           BNE ARYERR
0D75  C8          299           INY
0D76  C8          300           INY                 ; POINT TO NROWSL
0D77  B1 83       301           LDA (VARPNT),Y
0D79  AA          302           TAX
0D7A  C5 A2       303           CMP MAXN
0D7C  88          304           DEY
0D7D  B1 83       305           LDA (VARPNT),Y
0D7F  E5 A3       306           SBC MAXN+1          ; IS YSIZ>XSIZ?
0D81  B0 1C       307           BCS YSIZOK          ; YSIZ>XSIZ
0D83  86 A2       308           STX MAXN
0D85  B1 83       309           LDA (VARPNT),Y      ; GET HI BACK
0D87  85 A3       310           STA MAXN+1
0D89  38          311           SEC
0D8A  A5 A2       312           LDA MAXN
0D8C  E5 9E       313           SBC INDX
0D8E  AA          314           TAX
0D8F  A5 A3       315           LDA MAXN+1
0D91  E5 9F       316           SBC INDX+1
0D93  B0 02       317           BCS YROWSGTN
0D95  90 A9       318           BCC NRNGERR
0D97  30 A7       319 YROWSGTN  BMI NRNGERR
0D99  D0 04       320           BNE YSIZOK
0D9B  E0 02       321           CPX #2              ;AT LEAST TWO MORE ARRAY EL
0D9D  90 A1       322           BCC NRNGERR         ; YSIZ<N
0D9F              323 YSIZOK    EQU *
0D9F  A5 83       324           LDA VARPNT
0DA1  18          325           CLC
0DA2  69 07       326           ADC #7
0DA4  85 A8       327           STA YVPTR
0DA6  A6 84       328           LDX VARPNT+1
0DA8  90 01       329           BCC *+3
0DAA  E8          330           INX
0DAB  86 A9       331           STX YVPTR+1
0DAD  06 9E       332           ASL INDX
0DAF  26 9F       333           ROL INDX+1          INDX=INDX*2
```

```
0D81: A5 A8       334              LDA YVPTR
0D83: A6 A9       335              LDX YVPTR+1
0D85: 20 F0 0E    336              JSR ADDINX
0D88: 84 A8       337              STY YVPTR
0D8A: 85 A9       338              STA YVPTR+1
0D8C: A5 A6       339              LDA XVPTR
0D8E: A6 A7       340              LDX XVPTR+1
0DC0: 20 F0 0E    341              JSR ADDINX
0DC3: 84 A6       342              STY XVPTR
0DC5: 85 A7       343              STA XVPTR+1
0DC7: 46 9F       344              LSR INDX+1
0DC9: 66 9E       345              ROR INDX          ; INDX=INDX/2
0DCB:             346              PAGE
0DCB: A9 00       347              LDA #0
0DCD: 8D BC 02    348              STA RTNCD
0DD0: AC 9B 02    349              LDY SAVSLOT
0DD3: 98          350              TYA               ;PUT IN A
0DD4: 38          351              SEC               ; FOR SUBTRACT
0DD5: E9 C1       352              SBC #$C1          ; IT VALID SLOT?
0DD7: C9 07       353              CMP #7
0DD9: B0 0B       354              BCS BADMODE       ;SLOT NOT INITED!!!
0DDB: B9 BB 03    355              LDA PAGE,Y
0DDE: 10 06       356              BPL BADMODE
0DE0: 29 7F       357              AND #$7F
0DE2: C9 20       358              CMP #HIRES1
0DE4: B0 05       359              BCS MODEOK
0DE6: A2 73       360 BADMODE      LDX #XNOTHGR
0DE8: 4C A3 0C    361              JMP BITPERR
0DEB: 29 03       362 MODEOK       AND #3
0DED: AC 16 0C    363              LDY MAXY
0DF0: AA          364              TAX               ;IS IT MIXED MODE?
0DF1: F0 06       365              BEQ NOTMIXD
0DF3: C0 A0       366              CPY #MXYVALU
0DF5: 90 02       367              BCC NOTMIXD
0DF7: A0 A0       368              LDY #MXYVALU
0DF9: 84 AA       369 NOTMIXD      STY TMAXY
0DFB: A2 02       370              LDX #POINT
0DFD: 8E 9A 02    371              STX SAVSLOT-1
0E00: 20 E1 0E    372              JSR JSRINDRCT
0E03: AD B0 02    373              LDA TEM
0E06: 29 03       374              AND #3
0E08: C9 03       375              CMP #3            ; IS PEN UP?
0E0A: F0 0A       376              BEQ KYBDXIT       ; YES. HE HIT KEYBD
0E0C: 20 F8 0E    377              JSR WINDOCHK      ;IS IT ON SCREEN?
0E0F: B0 06       378              BCS ONSCRN        ; YEP
0E11: A9 01       379 YTOOBIG      LDA #1            ;PEN OFF SCREEN EXIT
0E13: 8D BC 02    380 STRTNCD      STA RTNCD
0E16: 60          381 KYBDXIT      RTS
0E17              382 ONSCRN       EQU *
0E17: AD B7 02    383              LDA TEMYL
0E1A: AE B5 02    384              LDX TEMXL
0E1D: AC B6 02    385              LDY TEMX
0E20: 20 57 F4    386              JSR HPLOT
0E23:             387 MAINLP       EQU *
0E23: 24 A5       388              BIT TICFLG
0E25: 30 0B       389              BMI NOTICK
0E27:             390 TICKLE       EQU *
0E27: AD 30 C0    391              LDA SPKR
0E2A: A9 0F       392              LDA #$0F
0E2C: 20 A8 FC    393              JSR WAIT
0E2F: AD 30 C0    394              LDA SPKR          ; TICK IT
0E32:             395 NOTICK       EQU *
0E32: AD B6 02    396              LDA TEMX
0E35: A0 00       397              LDY #0
0E37: 91 A6       398              STA (XVPTR),Y
0E39: AD B8 02    399              LDA TEMY
0E3C: 91 A8       400              STA (YVPTR),Y     ; STORE Y VALU
0E3E: C8          401              INY
0E3F: AD B5 02    402              LDA TEMXL         ; STORE X VALUE
0E42: 91 A6       403              STA (XVPTR),Y
0E44: AD B7 02    404              LDA TEMYL
0E47: 91 A8       405              STA (YVPTR),Y
```

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0E49:                   406                 PAGE
0E49  A2 01             407                 LDX #1
0E4B: E6 A6             408 XVINC           INC XVPTR
0E4D: D0 02             409                 BNE *+4
0E4F: E6 A7             410                 INC XVPTR+1
0E51: CA                411                 DEX
0E52: F0 F7             412                 BEQ XVINC
0E54: A2 01             413                 LDX #1
0E56: E6 A8             414 YVINC           INC YVPTR
0E58: D0 02             415                 BNE *+4
0E5A: E6 A9             416                 INC YVPTR+1
0E5C: CA                417                 DEX
0E5D: F0 F7             418                 BEQ YVINC
0E5F: E6 9E             419                 INC INDX
0E61: D0 02             420                 BNE *+4
0E63: E6 9F             421                 INC INDX+1
0E65:                   422 *    ;Y=1 FROM ABOVE!
0E65: A5 9E             423                 LDA INDX
0E67: 91 A0             424                 STA (NADRS),Y
0E69: 88                425                 DEY                 ; Y=0
0E6A: A5 9F             426                 LDA INDX+1
0E6C: 91 A0             427                 STA (NADRS),Y
0E6E: A5 9E             428                 LDA INDX
0E70  C5 A2             429                 CMP MAXN
0E72: A5 9F             430                 LDA INDX+1
0E74: E5 A3             431                 SBC MAXN+1          ; IS N<MAX ?
0E76: 90 05             432                 BCC MORPTS          ; YES
0E78: A9 03             433                 LDA #3              ;ARRAY OVRLFD=3
0E7A: 4C 13 0E          434                 JMP STRTNCD         ; GO EXIT
0E7D: AE 98 02          435 MORPTS          LDX SAVSLOT
0E80: 8E FB 07          436                 STX MSLOT           ; TO BE SURE!
0E83:                   437 WAITLP          EQU *
0E83: 20 F9 CE          438                 JSR MREAD
0E86: AD 80 02          439                 LDA TEM
0E89: 29 03             440                 AND #3              ; IS PEN DOWN?
0E8B: F0 05             441                 BEQ PENDOWN         ; YES
0E8D: A9 02             442                 LDA #2              ; PEN UP RTN CODE
0E8F: 4C 13 0E          443                 JMP STRTNCD
0E92: A2 03             444 PENDOWN         LDX #3
0E94: BD 81 02          445 MVLP            LDA XFLL,X
0E97: 9D 85 02          446                 STA TEMXL,X
0E9A: CA                447                 DEX
0E9B: 10 F7             448                 BPL MVLP
0E9D: AE 98 02          449                 LDX SAVSLOT
0EA0: 20 FC CE          450                 JSR SCALE           ; SCALE RESULTS'
0EA3: 20 F8 0E          451                 JSR WINDOCHK        ; IS IT ON SCREEN
0EA6: B0 03             452                 BCS CKDLTA          ;YES SO GO ON
0EA8: 4C 11 0E          453                 JMP YTOOBIG         ; YES EXIT
0EAB:                   454 CKDLTA          EQU *               ; IS NEW POINT IN
0EAB: AD 87 02          455                 LDA TEMYL           ; THE WINDOW ?
0EAE: 38                456                 SEC
0EAF: E5 E2             457                 SBC YO              ; PREVIOUS Y
0EB1: B0 04             458                 BCS CKYDLTA
0EB3: 49 FF             459                 EOR #$FF
0EB5: 69 01             460                 ADC #1
0EB7: C5 9D             461 CKYDLTA         CMP DELTA           ; IN WINDOW?
0EB9: B0 17             462                 BCS PLOTSEQ         ; NO SO DO IT
0EBB: 38                463                 SEC
0EBC: AD 85 02          464                 LDA TEMXL
0EBF: E5 E0             465                 SBC XOL             ; X PREVIOUS
0EC1: AA                466                 TAX
0EC2: AD 86 02          467                 LDA TEMX
0EC5: E5 E1             468                 SBC XOH
0EC7: 8A                469                 TXA
0EC8: B0 04             470                 BCS CKXDLTA
0ECA: 49 FF             471                 EOR #$FF
0ECC: 69 01             472                 ADC #1
0ECE:                   473 CKXDLTA         EQU *
0ECE: C5 9D             474                 CMP DELTA
0ED0: 90 B1             475                 BCC WAITLP          ; WAIT TILL PEN MOVES
0ED2: AD 85 02          476 PLOTSEQ         LDA TEMXL
0ED5: AE 86 02          477                 LDX TEMX
0ED8: AC 87 02          478                 LDY TEMYL
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0EDB: 20 3A F5    479              JSR HILIN              PLOT LINE SEQ
0EDE: 4C 23 0E    480              JMP MAINLP
0EE1:             481 ************************
0EE1:             482 * MY SUBROUTINES
0EE1              483 ************************
0EE1: 6C 9A 02    484 JSRINDRCT    JMP (SAVBLOT-1)
0EE4:             485 ************************
0EE4: BD 09 0C    486 SETNAME      LDA VNAMTAB,X
0EE7: 85 81       487              STA VARNAM
0EE9: E8          488              INX
0EEA: BD 09 0C    489              LDA VNAMTAB,X
0EED: 85 82       490              STA VARNAM+1
0EEF: 60          491              RTS
0EF0:             492 ************************
0EF0: 18          493 ADDINX       CLC
0EF1: 65 9E       494              ADC INDX
0EF3: A8          495              TAY
0EF4: 8A          496              TXA
0EF5: 65 9F       497              ADC INDX+1
0EF7: 60          498              RTS
0EF8:             499 ************************
0EF8: AD 85 02    500 WINDOCHK     LDA TEMXL
0EFB: AA          501              TAX                    ;SAVE IT
0EFC: CD 11 0C    502              CMP MINXL
0EFF: AD 86 02    503              LDA TEMX
0F02  A8          504              TAY                    ; SAVE TOO
0F03: ED 12 0C    505              SBC MINX               ; IS X >= MIN ?
0F06: 90 0D       506              BCC WCHKRTS            ; NO OUTSIDE
0F08: 8A          507              TXA                    ;GET LO BACK
0F09: CD 13 0C    508              CMP MAXXL
0F0C: 98          509              TYA                    ; GET HI BACK
0F0D: ED 14 0C    510              SBC MAXX               ; IS X< MAXX
0F10: 90 02       511              BCC XINSIDE            ; YES X IN SIDE
0F12: 18          512 OUTSIDE      CLC                    ; C=0 SAYS NO
0F13. 60          513 WCHKRTS      RTS
0F14: AD 88 02    514 XINSIDE      LDA TEMY               ;ADDED 4/25/79 JOA
0F17: D0 F9       515              BNE OUTSIDE            ;ADDED 4/25/79 JOA
0F19: AD 87 02    516              LDA TEMYL              ;CHANGED 4/25/79 JOA
0F1C: CD 15 0C    517              CMP MINY               ;IS Y>= MIN Y ?
0F1F: 90 F2       518              BCC WCHKRTS            ; NO OUTSIDE
0F21: C5 AA       519              CMP TMAXY              ; IS Y < MAX Y ?
0F23: B0 ED       520              BCS OUTSIDE            ; NO OUTSIDE
0F25: 38          521 INSIDE       SEC
0F26: 60          522              RTS
0F27:             523              PAGE
0F27:             524 ************************
0F27: A6 69       525 FINDARY      LDX ARYTAB
0F29: A5 6C       526              LDA ARYTAB+1
0F2B: 86 9B       527 FNDLPA       STX LOWTR
0F2D: 85 9C       528              STA LOWTR+1
0F2F: C5 6E       529              CMP STREND+1
0F31: D0 04       530              BNE FNDFDV
0F33: E4 6D       531              CPX STREND
0F35: F0 5C       532              BEQ NOTFND
0F37. A0 00       533 FNDFDV       LDY #0
0F39: B1 9B       534              LDA (LOWTR),Y
0F3B: C8          535              INY
0F3C: C5 81       536              CMP VARNAM
0F3E: D0 06       537              BNE NXTARY
0F40: A5 82       538              LDA VARNAM+1
0F42: D1 9B       539              CMP (LOWTR),Y
0F44  F0 0E       540              BEQ GOTARY
0F46. C8          541 NXTARY       INY
0F47: B1 9B       542              LDA (LOWTR),Y
0F49: 18          543              CLC
0F4A: 65 9B       544              ADC LOWTR
0F4C: AA          545              TAX
0F4D: C8          546              INY
0F4E: B1 9B       547              LDA (LOWTR),Y
0F50. 65 9C       548              ADC LOWTR+1
0F52: 90 D7       549              BCC FNDLPA
0F54: A9 00       550 GOTARY       LDA #0
0F56: F0 2D       551              BEQ ADJVPTR
```

```
0F58:                  552              PAGE
0F58:                  553 ************************
0F58: A5 69            554 FINDVAR      LDA VARTAB
0F5A: A6 6A            555              LDX VARTAB+1
0F5C: A0 00            556              LDY #0
0F5E: 86 9C            557 FNDLPX       STX LOWTR+1
0F60: 85 9B            558 FINDLP       STA LOWTR
0F62: E4 6C            559              CPX ARYTAB+1
0F64: D0 04            560              BNE LOPFN
0F66: C5 6B            561              CMP ARYTAB
0F68: F0 29            562              BEQ NOTFND
0F6A: A5 B1            563 LOPFN        LDA VARNAM
0F6C: D1 9B            564              CMP (LOWTR),Y
0F6E: D0 08            565              BNE NOTIT
0F70: A5 B2            566              LDA VARNAM+1
0F72: C8               567              INY
0F73: D1 9B            568              CMP (LOWTR),Y
0F75: F0 CC            569              BEQ FOUNDS
0F77: 88               570              DEY
0F78: 18               571 NOTIT        CLC
0F79: A5 9B            572              LDA LOWTR
0F7B: 69 07            573              ADC #7
0F7D: 90 E1            574              BCC FINDLP          ; X,A SET UP
0F7F: E8               575              INX                  ; DO CARRY TO HI
0F80: D0 DC            576              BNE FNDLPX          ; X,A SET NOW
0F82: 00               577              BRK                  ; INSURANCE!
0F83: A9 02            578 FOUNDS       LDA #2
0F85: 18               579 ADJVPTR      CLC
0F86: 65 9B            580              ADC LOWTR
0F88: A4 9C            581              LDY LOWTR+1
0F8A: 90 01            582              BCC ADJDONE
0F8C: C8               583              INY
0F8D: 85 83            584 ADJDONE      STA VARPNT
0F8F: 84 84            585              STY VARPNT+1
0F91: 38               586              SEC
0F92: 60               587              RTS
0F93: 18               588 NOTFND       CLC
0F94: 60               589              RTS
0F95:                  590 ***********************
0F95:                  591 * GET USR NAMES FROM*
0F95:                  592 * HIS CALL LINE AND *
0F95:                  593 * USE THEM INSTEAD  *
0F95:                  594 * OF THE DEFAULTS   *
0F95:                  595 * THE USER ENTERS   *
0F95:                  596 * THE NAMES IN FIXED*
0F95:                  597 * POSITIONAL ORDER  *
0F95:                  598 * AS FOLLOWS        *
0F95:                  599 *  D%,N%,X%,Y%      *
0F95:                  600 ***********************
0F95                   601              PAGE
0F95:                  602 USRNAMS      EQU *
0F95: A2 07            603              LDX #7
0F97: BD F8 0F         604 DFLTS        LDA DEFALT,X
0F9A: 9D 09 0C         605              STA VNAMTAB,X
0F9D: CA               606              DEX
0F9E: 10 F7            607              BPL DFLTS
0FA0: 20 B7 00         608              JSR CHRGOT          ; GET NEXT CHR
0FA3: D0 01            609              BNE *+3
0FA5: 60               610              RTS                 ;EXIT, END OF STMT
0FA6: 20 7D E0         611              JSR ISLETC          ;A LETTER?
0FA9: 90 18            612              BCC GETLTR          ;NO, IGNORE IT
0FAB: 20 E7 0F         613 SET1ST       JSR STORIT          ;YES , USE
0FAE: F0 31            614              BEQ UNAMRTS
0FB0: 20 F0 0F         615 ISTAIL       JSR MYCHGET         ; GET NEXT
0FB3: 90 1E            616              BCC SET2ND          ; DIGIT OK
0FB5: 20 7D E0         617              JSR ISLETC          ; A LETTER?
0FB8: B0 19            618              BCS SET2ND          ; YES, USE
0FBA: C9 2C            619              CMP #$2C              NO,  A COMMA ?
0FBC: D0 F2            620              BNE ISTAIL          ;NOT COMMA, IGNORE
0FBE: E8               621 NXTX         INX                  ;A COMMA SAYS NO 2ND
0FBF: E0 07            622              CPX #7              ; AM I DONE?
0FC1: B0 1E            623              BCS UNAMRTS         ;YEP
0FC3: 20 F0 0F         624 GETLTR       JSR MYCHGET          ; FIND A LTR
```

```
0FC6: 20 7D E0    625             JSR ISLETC          ; A LETTER?
0FC9: B0 E0       626             BCS SET1ST          ; YES DO NEXT ONE
0FCB: C9 2C       627             CMP #$2C            ; A COMMA ?
0FCD: D0 F4       628             BNE GETLTR          ;NO, IGNORE !
0FCF: E8          629             INX                  ; YES SKIP THIS NAME
0FD0: B8          630             CLV                  ;ALWAYS
0FD1  50 EB       631             BVC NXTX            ;TAKEN !
0FD3: 20 E7 0F    632 SET2ND      JSR STORIT
0FD6: F0 09       633             BEQ UNAMRTS
0FD8: 20 F0 0F    634 SCANC       JSR MYCHGET
0FDB: C9 2C       635             CMP #$2C            ; IS IT A COMMA?
0FDD: D0 F9       636             BNE SCANC           ;NO,KEEP LOOKING
0FDF: F0 E2       637             BEQ GETLTR          ;YES,BEGIN AGAIN
0FE1: 20 F0 0F    638 UNAMRTS     JSR MYCHGET         ; GET NEXT
0FE4: D0 FB       639             BNE UNAMRTS         ;FIND END OF STMT
0FE6: 60          640             RTS                 ;JUST IN CASE
0FE7: E8          641 STORIT      INX
0FE8: 09 80       642             ORA #$80            ; MUST BE ON
0FEA: 9D 09 0C    643             STA VNAMTAB,X
0FED: E0 07       644             CPX #7
0FEF: 60          645             RTS
0FF0: 20 B1 00    646 MYCHGET     JSR CHRGET          ; GET CHR
0FF3: D0 02       647             BNE *+4             ; NOT END OF TEXT
0FF5: 68          648             PLA
0FF6: 68          649             PLA                  ;CLEAR 1ST LEVEL RTS
0FF7: 60          650             RTS                  ;RTN TO CALLER OR HIS CALL
0FF8: C4 80       651 DEFALT      DFB $C4,$80
0FFA: CE 80       652             DFB $CE,$80
0FFC: D8 80       653             DFB $D8,$80
0FFE: D9 80       654             DFB $D9,$80

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

```
0000:                    1 *
0000:                    2 *VARIOUS BIT PAD HI-RES ROUTINES
0000:                    3 *BY DAVE M. LINCER
0000:                    4 *COPYRIGHT APPLE COMPUTER CO.
0000:                    5 *     JUNE 1979
0000:                    6 *
6000:                    7               ORG $6000
6000:                    8               OBJ $2000
6000:                    9 HBASL         EQU $00
6000:                   10 HBASH         EQU $01
6000:                   11 HMASK         EQU $02
6000:                   12 ZTEM          EQU $03
6000:                   13 XOL           EQU $2FF
6000:                   14 XOH           EQU $2FE
6000:                   15 YO            EQU $2FD
6000:                   16 FLGL          EQU $2FC
6000:                   17 FLGH          EQU $2FB
6000:                   18 XL            EQU FLGL
6000:                   19 XH            EQU FLGH
6000:                   20 *
6000:                   21 *WHITE PICK OFF
6000:                   22 *
6000: 8A                23 WHITE         TXA                     SAVE X,Y AND ZPG
6001: 48                24               PHA
6002: 98                25               TYA
6003: 48                26               PHA
6004: A2 03             27               LDX #$3
6006: B5 00             28 SLP           LDA $00,X
6008: 48                29               PHA
6009: CA                30               DEX
600A: 10 FA             31               BPL SLP; ZPG            SAVED
600C: AD FF 02          32               LDA XOL                 SELF MODIFY
600F  8D 55 60          33               STA PKE1                BCC INTO BCS
6012: 8D 91 60          34               STA PKE2
6015: A9 00             35               LDA #$00                INIT MY REGS
6017: 8D FD 02          36               STA YO                  TO UPPER LEFT
601A: 8D FF 02          37               STA XOL                 W/NO BITS ON
601D: 8D FE 02          38               STA XOH
6020: 8D FC 02          39               STA FLGL
6023. 8D FB 02          40               STA FLGH
6026: 20 C3 60          41               JSR HPOSN               FIRST TIME
6029. AE FF 02          42 BLOOP         LDX XOL                 NEXT TIME ONLY
602C  AC FE 02          43               LDY XOH                 CHANGE Y &
602F: 20 ED 60          44               JSR XPOS                HMASK
6032: B1 00             45               LDA (HBASL),Y           DO AN
6034: 25 02             46               AND HMASK               HSCRN @ X,Y
6036: 85 03             47               STA ZTEM                SAVE BIT
6038: F0 02             48               BEQ ITZOFF              ??
603A: A9 01             49               LDA #$01                NOPE
603C: 18                50 ITZOFF        CLC                      YUP
603D: 6D FC 02          51               ADC FLGL                INC FLG CNTR
6040: 8D FC 02          52               STA FLGL                BY BIT ON
6043: 29 00             53               AND #$00                ;CARRY FROM LOW ADD
6045: 6D FB 02          54               ADC FLGH                ;IS ADDED TO FLGH
6048: 8D FB 02          55               STA FLGH
604B: AD FC 02          56               LDA FLGL                IS THERE MORE
604E: C9 02             57               CMP #$02                THAN 2 BITS ON
6050: AD FB 02          58               LDA FLGH                2 BYTE TEST
6053: E9 00             59               SBC #$00
6055: 90 0A             60 PKE1          BCC LN130               CS FOR DEL WHITE
6057: A5 03             61               LDA ZTEM                BIT?
6059: D0 06             62               BNE LN130               ON?
605B: 20 02 61          63               JSR CLER                NO,OFF
605E. 4C 73 60          64               JMP NXTX                NEXT HORZ POS
6061: AD FC 02          65 LN130         LDA FLGL                IS ANY ON?
6064  0D FB 02          66               ORA FLGH
6067  F0 04             67               BEQ ZFG                 NO
6069: A5 03             68               LDA ZTEM                YES AND IF
606B: D0 06             69               BNE NXTX                Z=1 THEN OK
```

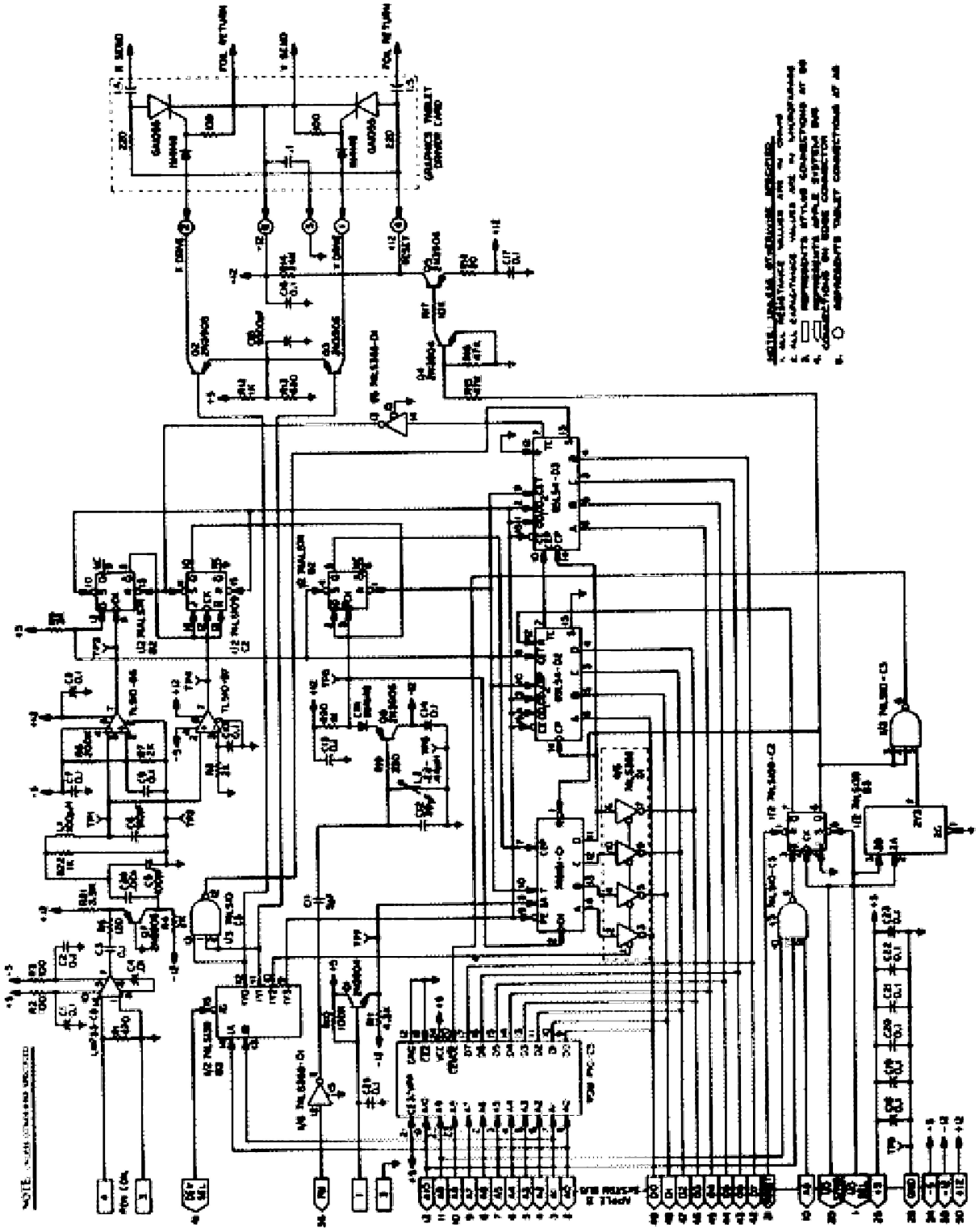
```
606D: 8D FC 02      70 ZFG          STA FLGL            ELSE ZERO
6070: 8D FB 02      71              STA FLGH            FLAG
6073: EE FF 02      72 NXTX         INC XOL             INC CNT FIRST
6076: D0 03         73              BNE TESTX           THEN TEST
6078: EE FE 02      74              INC XOH             X HIGH
607B: AD FF 02      75 TESTX        LDA XOL             2 BYTE TEST
607E: C9 18         76              CMP #$18            FOR XPOS=
6080: AD FE 02      77              LDA XOH             279 OR
6083: E9 01         78              SBC #$01            $118
6085: 90 A2         79              BCC BLOOP           IF OK ELSE
6087: AD FC 02      80              LDA FLGL            END OF X LOOP
608A: C9 02         81              CMP #$02            MAKE SURE TO
608C: AD FB 02      82              LDA FLGH            CATCH LAST
608F: E9 00         83              SBC #$00            WHITE OR COLOR
6091: 90 03         84 PKE2         BCC NXTY            CS FOR DEL COLR
6093: 20 02 61      85              JSR CLER            CLEAR OUT
6096: A9 00         86 NXTY         LDA #$00            RESET X AND
6098: 8D FC 02      87              STA FLGL            FLAG
609B: 8D FB 02      88              STA FLGH
609E: 8D FF 02      89              STA XOL
60A1: 8D FE 02      90              STA XOH
60A4: EE FD 02      91              INC YO              THEN INC YO
60A7: 20 C3 60      92              JSR HPOSN           REPOSN
60AA: AD FD 02      93              LDA YO              AND TEST
60AD: C9 C0         94              CMP #$C0            FOR Y=191
60AF: B0 03         95              BCS RET1            WE'RE DONE
60B1: 4C 29 60      96              JMP BLOOP           NO CONTINUE (LONG BRANCH)
60B4: A2 00         97 RET1         LDX #$00            BRING BACK ALL
60B6: 68            98 RLP          PLA                 ZPAGE
60B7: 95 00         99              STA $00,X           AND X,Y
60B9: E8           100              INX
60BA: E0 04        101              CPX #$04
60BC: D0 F8        102              BNE RLP
60BE: 68           103              PLA
60BF: A8           104              TAY
60C0: 68           105              PLA
60C1: AA           106              TAX
60C2: 60           107              RTS
60C3:              108 *
60C3:              109 *HPOSN HRES BIT POSN ROUT
60C3:              110 *READ ABOUT THIS CODE IN UTILITY ROM MANUAL
60C3:              111 *
60C3: AD FD 02     112 HPOSN       LDA YO
60C6: AE FF 02     113             LDX XOL
60C9: AC FE 02     114             LDY XOH
60CC: 48           115 HPOS        PHA
60CD: 29 C0        116             AND #$C0
60CF: 85 00        117             STA HBASL
60D1: 4A           118             LSR A
60D2: 4A           119             LSR A
60D3: 05 00        120             ORA HBASL
60D5: 85 00        121             STA HBASL
60D7: 68           122             PLA
60D8: 85 01        123             STA HBASH
60DA: 0A           124             ASL A
60DB: 0A           125             ASL A
60DC: 0A           126             ASL A
60DD: 26 01        127             ROL HBASH
60DF: 0A           128             ASL A
60E0: 26 01        129             ROL HBASH
60E2: 0A           130             ASL A
60E3: 66 00        131             ROR HBASL
60E5: A5 01        132             LDA HBASH
60E7: 29 1F        133             AND #$1F
60E9: 09 40        134             ORA #$40
60EB: 85 01        135             STA HBASH
60ED: BA           136 XPOS        TXA                 THIS ENTRY ONLY
60EE: C0 00        137             CPY #$0             COMPUTES Y & HMASK
60F0: F0 05        138             BEQ HPOSN2
60F2: A0 23        139             LDY #$23
60F4: 69 04        140             ADC #$4
60F6: C8           141 HPOSN1      INY
```

```
60F7- E9 07      142 HPOSN2      SBC #$7
60F9- D0 FB      143             BCS HPOSN1
60FB- AA         144             TAX
60FC- BD 4F 60   145             LDA MSKTBL-249,X
60FF- 85 02      146             STA HMASK
6101- 60         147             RTS
6102             148 *
6102             149 *CLER CLEAR BACK FLG+1 BITS
6102             150 *
6102- 38         151 CLER        SEC                 FIND XO-FLG
6103- AD FF 02   152             LDA XOL             DOUBLE BYTE
6106- ED FC 02   153             SBC FLGL
6109- 8D FC 02   154             STA XL
610C- AD FE 02   155             LDA XOH
610F- ED FB 02   156             SBC FLGH
6112- 8D FB 02   157             STA XH              WITH RESULT IN XL,XH
6115- AE FC 02   158 CLOP        LDX XL              SETUP FOR XPOSN
6118- AC FB 02   159             LDY XH
611B- 20 ED 60   160             JSR XPOS
611E- A5 02      161             LDA HMASK           DELETE THE BIT
6120- 49 FF      162             EOR #$FF            @ Y,HMASK
6122- 31 00      163             AND (HBASL),Y       ON LINE HBASL
6124- 91 00      164             STA (HBASL),Y
6126- 18         165             CLC
6127- AD FC 02   166             LDA XL              FAKE OUT TEST SO
612A- 69 01      167             ADC #$01            THAT
612C- CD FF 02   168             CMP XOL             WE ONLY GO TO
612F- AD FB 02   169             LDA XH              XO-1
6132- ED FE 02   170             SBC XOH
6135- EE FC 02   171             INC XL
6138- D0 03      172             BNE XOK             NOW INC XL,XH
613A- EE FB 02   173             INC XH
613D- 90 D6      174 XOK         BCC CLOP            CONTINUE
613F- A9 00      175             LDA #$00            DONE CLEAR
6141- 8D FC 02   176             STA FLGL            FLAG
6144- 8D FB 02   177             STA FLGH
6147- 60         178             RTS                 AND RETURN
6148             179 *
6148             180 *MSKTBL HMASK LOOKUP TABLE
6148             181 *
6148- 01 02 04
614B- 08         182 MSKTBL      DFB $01,$02,$04,$08
614C- 10 20 40   183             DFB $10,$20,$40
614F             184             PAGE
614F             185 *
614F             186 *HIRES PICK STUPID PICK ROUTINE
614F             187 *
614F             188 *ALTM = $80 FOR COLOR SET 1
614F             189 *ALTM = $00 FOR COLOR SET 2
614F             190 *COLR = $AA FOR PUR&BLU
614F             191 *COLR = $D5 FOR GRN&ORG
614F             192 *
614F             193 ALTM        EQU $2FE
614F             194 COLR        EQU $2FF
614F             195 A1L         EQU $00
614F             196 A1H         EQU $01
614F             197 *
614F             198 *HIRES PICK OFF
614F             199 *
614F- 98         200 HPICK       TYA                 SAVE Y,X AND ZPG
6150- 48         201             PHA
6151- A5 00      202             LDA A1L             $00
6153- 48         203             PHA
6154- A5 01      204             LDA A1H             $01
6156- 48         205             PHA
6157- A0 00      206             LDY #$00            SET INDEX
6159- 84 00      207             STY A1L             SET ZPG CTRS
615B- A9 40      208             LDA #$40
615D- 85 01      209             STA A1H             TO BEGINNING OF
615F- B1 00      210 LOOP        LDA (A1L),Y         PICK UP BYTE
6161- 4D FE 02   211             EOR ALTM            CHANGE SETBIT
6164- 30 04      212             BMI OKBYT           IF RIGHT SET
```

```
6166  A9 00       213              LDA #00            WRONG SET CLR BYT
6168  F0 0C       214              BEQ STOR1          ALWAYS TAKEN
616A  A5 00       215 OKBYT        LDA A1L            ARE ON ODD OR EVEN
616C  4A          216              LSR A              BYTE? THE CARRY KNOWS
616D  AD FF 02    217              LDA COLR           IF EVEN THEN
6170  B0 02       218              BCS STOR           SHIFT ELSE STOR
6172  49 7F       219              EOR #$7F           SHIFT MASK
6174  31 00       220 STOR         AND (A1L),Y        WIPE OUT EXTRA
6176  91 00       221 STOR1        STA (A1L),Y        AND STORE IT
6178  A5 00       222              LDA A1L            GOTO NEXT BYTE
617A  C9 FF       223              CMP #$FF           WITH TEST FOR
617C  A5 01       224              LDA A1H            END OF HSCRN
617E  E9 5F       225              SBC #$5F           ( $5FFF )
6180  E6 00       226              INC A1L
6182  D0 02       227              BNE CHLOP
6184  E6 01       228              INC A1H
6186  90 D7       229 CHLOP        BCC LOOP           CC ON NOT END
6188  68          230              PLA                RETURN Y AND ZPG
6189  85 01       231              STA A1H
618B  68          232              PLA
618C  85 00       233              STA A1L
618E  68          234              PLA
618F  A8          235              TAY
6190  60          236              RTS
6191              237              PAGE

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

APPENDIX E
SCHEMATIC DIAGRAM



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